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CONDENSER

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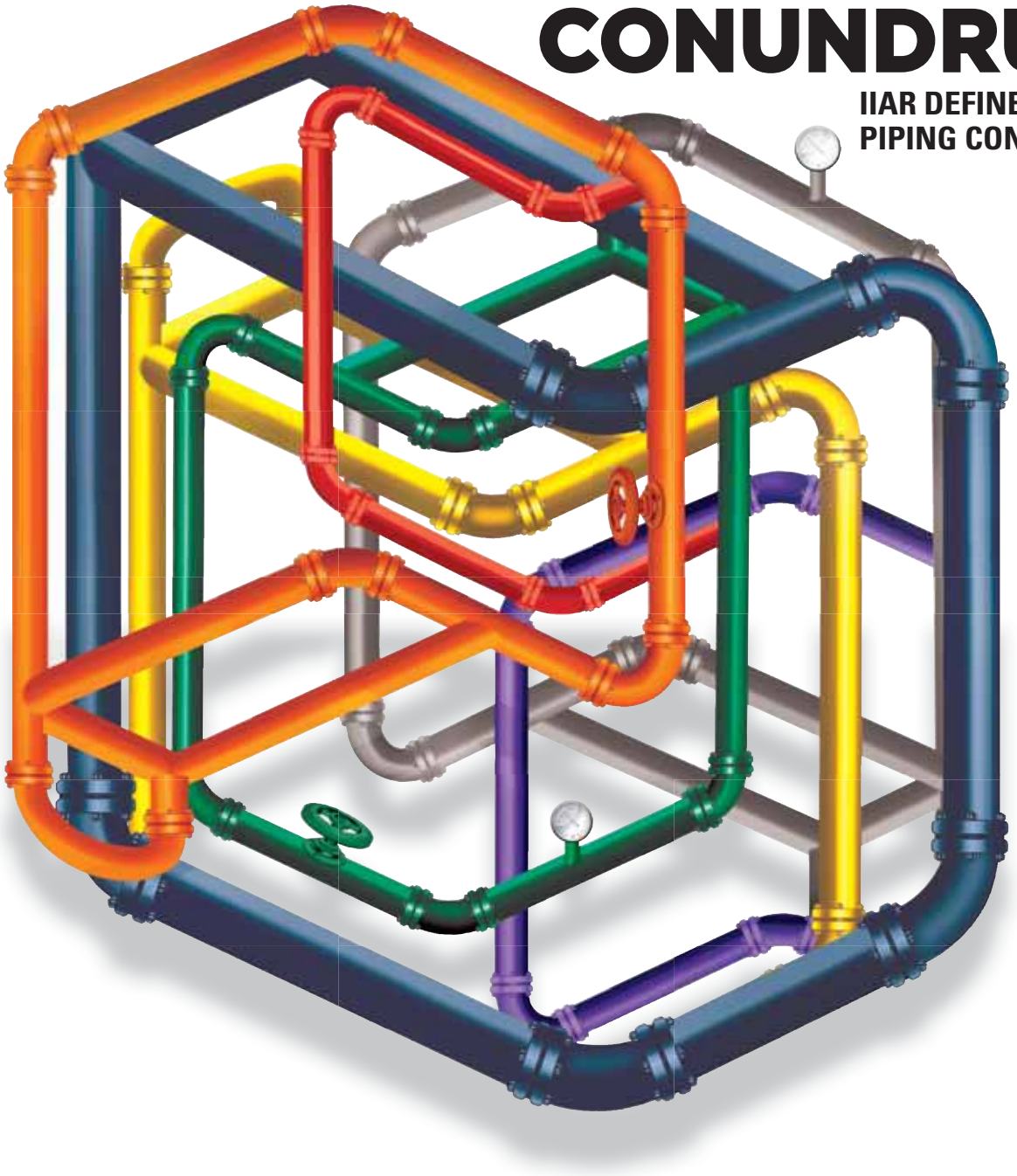
IIAR DEFINES PIPING CONVENTION



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The Color CONUNDRUM

IIAR DEFINES PIPING CONVENTION

The importance of color coding ammonia refrigeration piping is a generally accepted best practice these days, but the debate over which colors to use has been anything but black and white. Now, after nearly a decade of debate on the subject, the International Institute of Ammonia Refrigeration is poised to release a guideline for pipe color codes, finally putting the contentious issue to rest.

Government Relations Committee Focuses Attention on Regulatory Issues

IIAR Committees serve as a valuable forum for the open discussion of the critical issues facing the industry. IIAR's government relations committee is one of the organization's newest committees, focused on IIAR's mission of advocacy.

The purpose of the committee is to provide IIAR members with a strong understanding of how federal regulations affect the ammonia refrigeration industry. Don Stroud, who leads the government relations committee, said the group's primary focus is to follow regulations and proposed rulemakings from the Environmental Protection Agency, EPA, and the Occupational Safety and Health Administration, OSHA.

Much of the committee's recent focus has been on OSHA inspections of refrigeration systems, Stroud said, specifically OSHA's use of inspection guidelines that originally evolved for the petrochemical industry. "We are starting to see problems with how these inspections are being conducted when it comes to OSHA trying to apply petrochemical standards to refrigeration," he added.

The committee has been fielding quite a few questions from members on that subject. "We're trying to educate compliance officers about good working practices to help them deal with the inspections," Stroud said.

He noted that IIAR has been working closely with OSHA and the Global Cold Chain Alliance to resolve any issues with inspection processes.

The government relations committee has also been helping IIAR members understand the presidential executive order regarding chemical plant safety, which was issued in response to the April chemical plant explosion in West, Texas. The executive order seeks to improve coordination among federal, state and local officials with first responders.

"We're monitoring closely the effects of that executive order," Stroud said.

Meanwhile, the government relations committee followed developments related to OSHA regulations involving hydrostatic relief, he added. OSHA's position on that subject was highlighted in a letter known as the Palmer Letter, which stated that hydrostatic relief is required when equipment containing a liquid refrigerant can be isolated.

The government relations committee recently worked with the IIAR staff to clarify the Palmer letter, which resulted in OSHA revising their position, an action that was reported in the IIAR member alerts newsletter earlier this year.

The government relations committee also helps members understand the inspection process required under the National Environmental Policy Act, Stroud said. In many cases, IIAR members are paying NEPA-related fines when the citations that led to the fines were given in error.

"There are many instances where companies accept a NEPA-related fine because they do not have the resources to challenge the agency's decision," Stroud said. "We're working to provide some direction on that issue."

chairman's MESSAGE

BY BOB PORT

One of the most important functions of the IIAR Board of Directors is to set the strategic direction of the association every year. This year, board members met at the headquarters of ConAgra Foods in Omaha, Nebraska, to talk about ongoing initiatives and start making plans for the year ahead.

The ongoing initiative getting the most focus right now is the re-write of the IIAR-2 standard. As you may have read in the last issue of the Condenser, IIAR-2 is currently undergoing a comprehensive update to reflect the industry's technological change, and will evolve into a single source document for safety and design of ammonia refrigeration systems.

Prior to this update, IIAR-2 was more closely focused on design standards for systems and equipment with some coverage of installation. It has not previously covered all the aspects of safety that need to be considered, such as the applications of systems – where ammonia equipment can be used and how safety standards should be applied to different applications.

The new, updated document represents one of the most important efforts IIAR has ever undertaken on behalf of the industry, and it will have significant code implications.

That's why I'd like to take this opportunity to remind IIAR members to participate in the public review of the standard, which opens later this month. Your comments represent the knowledge base and voice of our industry, and have a significant impact on our future.

The development of IIAR-2 represents a great deal of work by staff and the IIAR Standards Committee, who are methodically working to incorporate public input and identify all the detail the updated standard should address.

The committee is currently working to meet the next 2014 publication deadline for updating IIAR-2, which is a very aggressive schedule considering the complexities of the American National Standards Institute guidelines that IIAR follows for development of IIAR standards.

Speaking of standards development, another one of IIAR's ongoing initiatives is to continue the process of refining IIAR's suite of eight standards.

As your Chairman, I have been charged with the creation of a task force to investigate how the use of ammonia in heat pump applications fits into our suite of standards.

These standards are important because they equip the industry with well-defined practices and designs. They also bridge some of the RAGAGAP that's currently in the field and address some of the lingering issues faced by the industry.

Another issue discussed at our Omaha meeting was the application of ammonia-based heat pumps and the fact that current IIAR standards don't necessarily cover their application. Understanding what the gap is when it comes to how we address heat pumps in our standards is a priority for IIAR.

As your Chairman, I have been charged with the creation of a task force to investigate how the use of ammonia in heat pump applications fits into our suite of standards.

I'm calling for volunteers to help form this important group, and encourage any member with an interest in the subject to contact IIAR headquarters.

Another topic that received some attention at the recent board meeting was a discussion about whether or not IIAR should have an energy efficiency committee.

Energy efficiency is an important, but broad subject, which is currently addressed by several different handbooks and publications across the industry. The major question for IIAR is: what information, if any, should the organization supply members on this subject? What would the purpose or output of an IIAR energy committee be?

Once again, I'd like to use this month's column to solicit input from IIAR members. If you have good ideas about energy efficiency, or are passionate about the subject, and have a vision for the direction of a future energy efficiency committee, we'd like to hear from you.

As always, your board is focused on many different initiatives. Some represent big steps the industry is taking to advance standards and safety, as in the case of the IIAR-2 rewrite. And some initiatives represent smaller, but just as important goals, like the creation of new task forces and committees.

It is the ongoing support and participation of IIAR members that make these conversations possible. Thank you for continuing to enrich our industry with your collaboration, input, and knowledge. ■

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president's MESSAGE

BY DAVE RULE

The second half of the year is always a challenging and busy time for the International Institute of Ammonia Refrigeration, and so far, 2013 has followed that precedent. As we wrap up this year's work on behalf of the industry, the IIAR leadership is pleased to report on several successful initiatives in many different areas. I am also excited to announce a record level of interest in our Heavy Equipment show, which will take place in Nashville, in March of next year.

The Heavy Equipment Show, which takes place every three years, has always been an event that allows the industry to highlight cutting edge technologies, and the 2014 event is no exception. Sales for the heavy equipment show, as well as the convention, are far ahead of schedule when compared to previous years. That growth is due to the increasing number of industry professionals who have come to regard the conference and show as invaluable learning and networking experiences.

The 2014 conference is slated to be one of the best yet, living up to the reputation of previous conferences with an in-depth display of technical knowledge in Nashville. Eight technical papers will make up the technical education program this year. The emphasis on innovation will also be found on the equipment show exhibition floor. In combination with the stellar technical track, the two events will give our members a great foundation for the year ahead.

Meanwhile, our industry understands that innovation is at the heart of sustained growth for the future. As technology changes, the perception of ammonia refrigeration in the marketplace is changing for the better. Low-charge systems could lead to new markets, especially on the commercial side, for our members. And innovation will also change how we view standards and codes. In fact, it's more important than ever to make sure the new codes and standards that are being formed now will foster the future innovation and growth of the industry.

> "The 2014 conference is slated to be one of the best yet, living up to the reputation of previous conferences with an in-depth display of technical knowledge in Nashville."

That's a topic that is sure to get some attention at the upcoming conference, but attendees will also see an emphasis on IIAR's Process Safety Management Program (PSM) and Risk Management Program (RMP). Compliance and safety are always important subjects, so we've devoted the Sunday before the conference to a full day of events meant to train and educate our members on the latest ideas and trends in both areas.

The first half of the Sunday program will feature an Ammonia Safety Training Day, sponsored by the Ammonia Safety Training Institute. It will focus on ASTI's 30 Minute Plan, meant to give facilities and first responders a solid plan for action during the most critical phase of an incident –the first 30 minutes. This event is free for attendees.

The second part of the day is a paid event that will focus on PSM and RMP, specifically, what to do when OSHA and EPA come knocking. We'll have subject-matter experts and examples of real-world situations that can help you prepare for an audit. From the basics of PSM, RMP, to a discussion of issues that can only be gained through experience, this program will extend your preparation beyond what's covered in IIAR manuals.

Events such as the ASTI Day and the PSM, RMP special session, are a main reason why the high number of sponsorship opportunities and exhibit booth space commitments for IIAR's Nashville conference have been filled well ahead of prior years. But the strong interest in IIAR membership also highlights the growing importance of our industry from an environmental perspective.

As global attitudes about issues such as climate change evolve, our industry has a chance to expand its presence in other nations. World leaders are realizing that ammonia is a viable solution in the elimination of ozone-depleting hydrofluorocarbons in their countries. And as our industry develops technologies that are affordable, practical and scalable, we are well-positioned to support the increased demand for new systems that is already occurring around the world.

The strength of IIAR lies in the collective spirit of its members, staff and partners. I want to thank all of you for your support in making 2013 such a successful year for the organization. I look forward to your continued support in 2014. ■

IIAR Developes Installation Standard

As part of IIAR's ongoing effort to create and update its comprehensive suite of standards, one small but important standard is set to be introduced next year.

IIAR-4 will address the installation of closed-circuit ammonia mechanical refrigeration systems, and compliments the larger IIAR-2 *Safety Standard for Equipment, Design, and Installation for Closed Circuit Mechanical Refrigeration Systems*

The creation of IIAR-4 is a key component in fulfilling the long-standing goal of having a set of "cradle to grave" standards written specifically for ammonia refrigeration systems, said Eric Smith, IIAR Vice President and Technical Director. He added that the goal of IIAR-4 is to separate and shift portions of IIAR-2 that address installation into a separate document and enhance current installation language where it is appropriate. It should be noted that because IIAR-2 is currently referenced by the International Mechanical Code (IMC) and the Uniform Mechanical Code (UMC), IIAR-2 will continue to retain installation language until IIAR-4 is published and adopted by these code bodies. When that occurs, installation aspects will then be removed from IIAR-2.

The new standard is meant to be a reference point for IIAR-2, said Dennis Carroll, ACUAIR application engineering manager. Carroll is the IIAR-4 sub-committee chairman leading the development of IIAR-4.

"In many ways, IIAR-4 is the little sister of IIAR-2," he said. "The goal IIAR-4 is to produce a clean document which solely addresses how to properly install a system. It doesn't address commissioning, design or anything else. It is installation in its purest sense, our industry's way of saying this is how we know to do it right."

IIAR's Smith agreed that although IIAR-4 is a smaller standard, it is just as important as IIAR-2 when it comes to safety.

"Following good installation practices is one of the most important pieces of the safety process," said Smith. "If your physical system isn't put together well, the best designs will not make a difference. Maintenance becomes an issue and the potential for releases become greater. This standard brings installation to the forefront and focuses attention on it as one of the most important pieces of everything that goes into building and operating a system."

While the standard may reflect knowledge that is already accepted as commonplace in the U.S. and many other countries with well-established ammonia refrigeration industries, it will serve as a valuable tool in places where the industry is just beginning to develop, said Carroll.

"We've written this standard in language that is consistent and clear enough that a layman or inspector who may not be as familiar with our systems can clearly understand it," he said. "It's written with a focus on practices used in North America, but the same good practices that apply here apply anywhere in the world where the goal is safety."

And that goal, to provide a common framework of information that reflects the best way to build, design operate and even decommission a system is at the heart of IIAR's mission to write a framework of standards that are based on years of industry experience, said Smith.

In keeping with ANSI/IIAR standards development procedures, the full draft of IIAR-4 is currently offered for public review until December 9, 2013. Subsequent public reviews will be provided on any substantive changes that occur before publication.

ARF news

AMMONIA REFRIGERATION FOUNDATION

ARF Welcomes New Trustee

The Ammonia Refrigeration Foundation said it recently named Mike McGinnis, president and owner of Innovative Refrigeration Systems, to the ARF board of trustees.

ARF, which serves as the research arm for industrial refrigeration, funds research projects and awards scholarships to support the growth of the industry.

The foundation's trustees are individuals who have made contributions to ARF of $50 thousand dollars each, and serve on the ARF Board of Directors.

"The ARF trustees play a very important role in making the goals of the foundation into a reality," said ARF Executive Director Tim Facius. "They are dedicated to the work of this industry and passionate about its future. We're very excited to welcome Mike to ARF's Board."

Currently, ARF is focused on bolstering its funding efforts so that it can continue to support its two primary initiatives, research and education.

"Mike has a keen understanding of ARF's mission and key objectives and I'm delighted that he will be taking an active role with the foundation," said Facius.

The Executive Order on Chemical Security: A Closer Look

iiar government RELATIONS

BY LOWELL RANDEL, IIAR GOVERNMENT RELATIONS DIRECTOR

On August 1st, President Obama announced the signing of an Executive Order entitled "Improving Chemical Facility Safety and Security." The Executive Order came in response to the explosion at a fertilizer plant in West, Texas earlier this year and aims to enhance the federal government's ability to prevent such accidents in the future. The order places a strong emphasis on improving communication and collaboration between federal agencies, and reflects the belief that better collaboration could have made a difference in the West incident.

"The order places a strong emphasis on improving communication and collaboration between federal agencies, and reflects the belief that better collaboration could have made a difference in the West incident."

The order identifies the following four major goals to improve chemical safety and security:

- improve operational coordination with state and local partners;
- enhance Federal agency coordination and information sharing;
- modernize policies, regulations and standards, and;
- work with stakeholders to identify best practices.

Since the signing, a chemical facility safety and security working group has been be formed to direct the federal government's efforts to implement the executive order. The working group is co-chaired by representatives from the Department of Homeland Security, the Environmental Protection Agency and the Department of Labor (OSHA). Other representatives on the working group include officials from the Department of Justice, Department of Agriculture and Department of Transportation.

The working group is directed to meet no less than quarterly to discuss the status of efforts to implement the executive order, and is tasked with providing a status report to the President within 270 days of the signing of the order. The executive order provides additional details on the timeline of activities proposed for implementation. While the deadlines will most assuredly be moved back as a result of the recent government shutdown, the following timeline gives an indication of the actions federal agencies will be taking over the coming months.

SEPTEMBER 15, 2013
(45 days after signing)
Deploy a pilot program to validate best practices and test methods for interagency collaboration regarding chemical safety and security.

- **Agencies involved:** Department of Homeland Security (DHS), Department of Transportation (DOT), Environmental Protection Agency (EPA) and Department of Labor (DOL).

OCTOBER 30, 2013
(90 days after signing)
Develop an analysis on improving information collection and data sharing to track non-compliant chemical facilities.

- **Agencies involved:** DHS, DOT, EPA and DOL
- The Executive Order also directs the agencies involved to discuss options to improve chemical risk management with key stakeholders within 90 days of completing the analysis on information collection.
- Develop options for improved chemical facility safety and security and identify improvements to existing risk management practices.
- **Agencies involved:** DHS, DOT, EPA and DOL
- Consult with the Chemical Safety Board (CSB) and determine what changes are required to existing memorandums of understanding and processes between EPA, ATF, OSHA and CSB for disclosure of information.
- **Agencies involved:** DHS, DOT, EPA, DOL and CSB
- The relationship between the CSB and regulatory and law enforcement agencies can be challenging, particularly when there is a criminal investigation. CSB is an independent non-regulatory agency with the mission of investigating industrial chemical accidents. Their goal is to determine the root cause of accidents, but not to assign criminal or regulatory culpability.
- Oftentimes, agencies conducting criminal investigations seek information from the CSB, including witness statements. This creates a chilling effect that can make CSB's job more difficult, as witnesses may

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be hesitant to speak with the CSB, for fear of criminal repercussions. Given this context, it will be interesting to see what, if any changes are made to the way CSB interacts with DHS, EPA and OSHA.

- Develop a list of regulatory and legislative proposals to improve safety and security around ammonium nitrate.
- **Agencies involved:** DHS, DOL and USDA

DECEMBER 14, 2013 (135 days after signing)
Develop a plan to support and further enable efforts by state regulators, state, local, and tribal emergency responders, chemical facility owners and operators, and local and tribal communities to work together to improve chemical facility safety and security.

- **Agencies involved:** DHS
- Assess data sharing related to CFATS with SERCs, TEPCs, and LEPCs

DECEMBER 14, 2013 (135 days after signing)
Develop a plan to support and further enable efforts by state regulators, state, local, and tribal emergency responders, chemical facility owners and operators, and local and tribal communities to work together to improve chemical facility safety and security.

"Of the activities in the executive order, potential changes to PSM and RMP may be of most interest to IIAR members. "

- Review the Risk Management Program (RMP) and Process Safety Management (PSM) and determine whether they should be expanded to address additional regulated substances and types of hazards.
- **Agencies involved:** EPA and DOL
- Assess data sharing related to storage of explosive materials through ATF with State Emergency Response Commissions (SERCs), Tribal Emergency Planning Committees (TEPCs) and Local Emergency Planning Committees (LEPCs).
- **Agencies involved:** DOJ
- Identify changes that need to be made in retail and commercial exemptions to the PSM standard and issue requests for information to identify ways to modernize PSM related to major chemical accidents.
- **Agencies involved:** DOL
- Identify a list of chemicals that should be considered for addition to the Chemical Facilities Anti-Terrorism Standards program (CFATS) Chemicals of Interest List.
- **Agencies involved:** DHS, DOT, EPA and DOL

JANUARY 28, 2104 (180 days after signing)
Recommend changes to streamline data collection to minimize duplication and lessen the reporting burden on regulated industries.

- **Agencies involved:** DHS, DOT, EPA and DOL

Produce a proposal for a coordinated, flexible data sharing process between agencies to track data submitted about chemical facilities.

- **Agencies involved:** DHS, DOT, EPA and DOL

Within 90 days after completion of this item, the executive order directs agencies to develop a plan for implementing practical and effective improvements to chemical risk management.

APRIL 28, 2014 (270 days after signing)
Create a set of comprehensive and integrated standard operating procedures to provide for a unified federal approach to identifying and responding to risks in chemical facilities.

- **Agencies involved:** DHS, DOT, EPA and DOL

The executive order lays out an ambitious number of activities on an aggressive timeline. These activities were essentially on hold during the government shutdown, so many, if not all, of the deadlines will slip. For example, plans to move forward with the pilot program to develop and test best practices on interagency collaboration have been pushed back. In addition, IIAR was scheduled to participate in a listening session regarding implementation of the executive order in early October. This session was cancelled and IIAR is awaiting news about rescheduling.

Of the activities in the executive order, potential changes to PSM and RMP may be of most interest to IIAR members. There are no indications at this time that anhydrous ammonia will be singled-out, or that major changes will be made to the underlying PSM and RMP regulations. However, there is some speculation that the Obama Administration may use this opportunity to advocate for the use of inherently safer technologies, or IST. The concept of IST is to reduce or eliminate hazards by adopting alternative technologies to make a given process safer.

Requiring companies to conduct IST assessments and adopt inherently safer technologies has been under consideration for several years. While many believe that using IST can be useful in appropriate settings, applying a regulatory mandate for IST is controversial and the practical implications can be very complex. DHS endorsed the concept of mandatory IST policies during debates regarding the future of the CFATS program, and IST was included in several legislative drafts to reauthorize CFATS. However, Congress is split on the issue of requiring mandatory IST, so using regulatory authority is seen as a more likely way for proponents to advance IST policy changes.

IIAR will continue to actively monitor the implementation of the executive order on improving chemical facility safety and security, and will keep members informed of any policy changes that may impact the industrial refrigeration industry. ■

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Firefighting with Refrigeration

iiar code advocacy **UPDATE**

BY JEFFREY M. SHAPIRO, P.E., FSFPE

IIAR has had much success in the past 15 years in the model code arena, updating codes to more appropriately regulate ammonia refrigeration. I'm sometimes asked how we were able to sway the opinions of so many fire safety regulators to support approval of IIAR proposals, and the answer, in a word, is "education."

There's an unwritten rule in the code development and code enforcement business that is sometimes applied to ammonia refrigeration and other complex topics: over-regulate what you don't understand. With this in mind, it makes sense that, to reduce the burden of unjustified regulations, IIAR needed to educate inspectors and emergency responders to better understand how ammonia refrigeration systems work. Code requirements for firefighter emergency control boxes serve as a good example of how this approach was effectively used to motivate a regulatory change.

On the surface, it might seem to be a daunting challenge to explain – to a firefighter, a fire inspector, or for that matter, anyone who has no education on the subject of mechanical refrigeration – how a refrigeration system works. However, firefighters and fire inspectors, who often come from firefighting ranks, actually know a lot more about the concept of refrigeration than they might realize. Firefighters use refrigeration every time they use water to extinguish a fire. In fact, we could coin a new firefighter job title that conveys a more superhero-like status, "The Evaporator." Let me explain . . .

Fundamentally, the role of a firefighter in extinguishing a room or compartment fire is all about absorbing the heat that is generated. As contents burn, heat is released into the compartment, and the compartment temperature will increase exponentially, often exceeding 1,000 degrees Fahrenheit in just a few minutes. Exposure to these conditions leads to progressive ignition of nearby combustibles, causing the fire to grow.

To stop this progression, firefighters use water deployed from fire hoses. A common initial attack technique taught in recruit school is discharging water through a fog nozzle, which breaks the discharge into small droplets that are "stirred" into the compartment as the nozzle is moved about by a firefighter.

The primary objective of this technique is absorbing heat, which in turn lowers the air temperature in the compartment. Firefighters are taught in recruit school that small droplets produced by a nozzle set to a fog pattern have a high surface-to-mass ratio, which enhances the efficiency of heat transfer over what can be achieved by setting the nozzle to a solid stream setting.

Firefighters also learn that the process of absorbing heat by converting water to steam takes advantage of the latent heat of vaporization, which is the amount of heat required to change a liquid to a vapor at the liquid's boiling point. In the case of water, a pound of liquid (roughly 16 fluid ounces) captures 1 BTU for each 1 degree Fahrenheit increase in temperature. However, when the temperature reaches the boiling point of 212 degrees, 970 BTUs are required (the latent heat of vaporization) for each pound of water to accomplish the phase change from liquid to steam while the temperature remains at 212 degrees. It's clear from these values that the process of changing water to steam is far more efficient in capturing heat than simply heating water in the liquid phase.

I'm obliged to point out that some fire departments choose to use solid streams rather than fog patterns for initial fire attack, espousing the benefits of reduced risk of steam burns to firefighters and more effective extinguishment by initially putting water directly onto whatever is burning. The merits of one approach versus the other continue to be a topic of spirited debate in firefighting circles.

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Firefighting with Refrigeration

By now, if you understand how ammonia refrigeration works, you should be seeing some parallels between ammonia refrigeration and firefighting. In the case of firefighting, water can be used as a refrigerant because compartment fires are hot! Capturing the latent heat of vaporization by converting water to steam at 212 degrees provides a satisfactory level of refrigeration to reduce compartment temperatures below the auto-ignition temperature for ordinary combustibles, which helps to stop a fire from spreading.

In contrast, water doesn't typically make a good industrial refrigerant because the heat transfer properties are poor at temperatures below the boiling point (latent heat of vaporization can't be utilized for heat transfer if you're below the temperature at which the liquid-to-vapor phase change occurs). Ammonia, on the other hand, facilitates much lower temperatures because ammonia boils at -28 degrees Fahrenheit. Accordingly, the latent heat of vaporization for ammonia, which is less than water, at 589 BTUs per pound, but is still orders of magnitude better than most other refrigerants – can be utilized all the way down to -28 degrees, at atmospheric pressure. In a refrigeration system, the evaporation of liquid ammonia to vapor ammonia typically takes place in an evaporator.

The parallels between ammonia refrigeration and firefighting actually run even deeper. For example:

- the water carried on a fire truck can be compared to liquid ammonia in an accumulator;
- the pump on a fire truck can be compared to the pump on a liquid ammonia recirculation system;
- the fire hose can be compared to liquid refrigerant supply piping;
- a fog nozzle can be compared to an expansion valve, and;
- the firefighter using a fog nozzle essentially plays the role of an evaporator.

Theoretically, if a burning compartment were tented and drained in such a way that evaporated water could be condensed, captured and transported back to the intake on a fire truck, along with runoff, the process of firefighters putting out a fire would equate to a closed refrigeration system.

With all of this in mind, you now know that we in the ammonia refrigeration industry do, in fact, have a lot in common with firefighters. We're all in the refrigeration business, but we use refrigeration for different purposes. Accordingly, when the crew from your local fire station shows up at your facility to do a pre-plan, or a local fire inspector shows up to do an inspection, you'll now be able to "feel the love" of a common cause. Escort them to an evaporator, point, and explain to them that they're a lot like that big box hanging off the ceiling. I bet that will be a great conversation starter! ■

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The Color CONUNDRUM

IIAR DEFINES PIPING CONVENTION

BY ANDREA FISCHER

The importance of color coding ammonia refrigeration piping is a generally accepted best practice these days, but the debate over which colors to use has been anything but black and white.

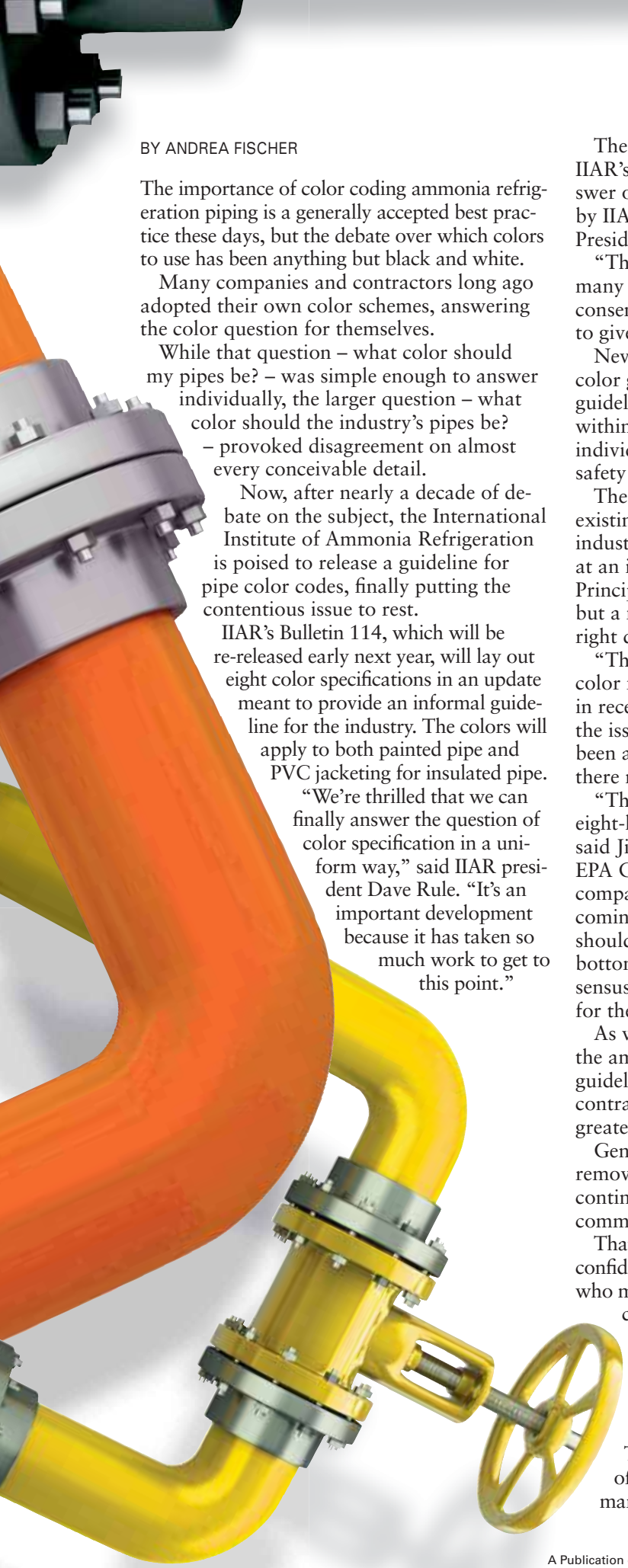
Many companies and contractors long ago adopted their own color schemes, answering the color question for themselves.

While that question – what color should my pipes be? – was simple enough to answer individually, the larger question – what color should the industry's pipes be? – provoked disagreement on almost every conceivable detail.

Now, after nearly a decade of debate on the subject, the International Institute of Ammonia Refrigeration is poised to release a guideline for pipe color codes, finally putting the contentious issue to rest.

IIAR's Bulletin 114, which will be re-released early next year, will lay out eight color specifications in an update meant to provide an informal guideline for the industry. The colors will apply to both painted pipe and PVC jacketing for insulated pipe.

"We're thrilled that we can finally answer the question of color specification in a uniform way," said IIAR president Dave Rule. "It's an important development because it has taken so much work to get to this point."



The new guidelines reflect years of work by IIAR's Piping Committee, and will finally answer one of the most common questions asked by IIAR members, said Eric Smith, IIAR's Vice President and Technical Director.

"This is important because there are so many people who come to us searching for consensus and until now, we haven't been able to give them a specific answer," he said.

Nevertheless, Smith cautioned that IIAR's color guidance should only be considered a guideline, and pointed out that provisions within the document leave the door open for individual color schemes as long as a common safety practice is followed.

The flexibility of being able to preserve existing color schemes will be welcome in an industry that currently defines piping colors at an individual facility level, said Jim Wright, Principal of Wright Engineering Associates, but a move towards consensus is a step in the right direction.

"The truth is, we've been specifying paint color for decades, and PVC pipe jacket colors in recent years," he said. "But as contractors, the issue was difficult because we've always been asked: what is IIAR's convention? And there never was one until now."

"The issue of color coding has been like the eight-hundred-pound gorilla in the room," said Jim Marrella, Coordinator of OSHA and EPA Compliance for U.S. Cold Storage. "Some companies did it and some didn't. The idea of coming to a consensus about what colors we should all use has been intimidating. But the bottom line is that we're moving toward consensus for the same reason, it's safer and easier for the industry as a whole."

As with other moves toward consensus in the ammonia refrigeration industry, color guidelines are seen by facility owners and contracting engineers as a vital step towards greater safety.

Generally, they say, such a standard will remove uncertainty, creating the kind of continuity that can serve as a foundation of common knowledge.

That foundation, in turn, will boost the confidence and effectiveness of any engineer who moves from facility to facility, whether as a contractor, or even as an employee.

"There is a great deal of fluidity to our industry," said IIAR past president Bruce Badger. "Most of the people who work in this industry, stay in this industry, even if they don't stay at the same company. There's an institutional safety benefit of having all the pipes in all our facilities marked according to the same color code."

And that institutional safety translates to efficiency, said IIAR's Dave Rule. From a training perspective, eliminating the need to bring new employees and contractors up to speed on facility-specific color schemes will mean a faster learning curve. At the same time, an industry-wide consensus will give emergency responders and anyone unfamiliar with an ammonia facility a common point of reference, he said.

"Whether people are coming into a facility as part of this industry, or as an outsider, common color coding should make our facilities more user friendly. No matter who you are, it's much easier to trace piping," said Smith.

Wright Engineering Associates' Jim Wright, agreed that the importance of being able to decipher an ammonia system quickly should not be underestimated.

"If a plant can provide identification of their piping at a glance, without the need to read labels or refer to facility-specific keys, we have the ability to take in the complexity of a system from a ten-thousand foot level," he said.

"We can see what's happening immediately. It's a huge advantage from a training and continuity perspective, and the net result is an increasingly safe operating environment."

And industry consensus on pipe color is something many facilities have been waiting on for a long time, precisely because the safety and training benefit could be so big, said Jeremy Corselli, Engineering Manager for Rancho Cold Storage.

"When a new operator walks into a new job position, he'll be able to immediately identify lines. And all we have to do is follow the IIAR guidance. We no longer need to worry about what color scheme works best, we already know," he said.

Meanwhile, Don Hamilton, Product Development Manager for Evapco, and the head of IIAR's Piping Committee, said a major goal of color standardization is to streamline emergency response.

"One of the biggest goals here is to make sure piping can be easily and quickly identified in an emergency situation," he said. "You need common color scheming across the industry to accomplish that goal, and right now it's missing."

Emergency response is one of the biggest reasons the industry should adopt common color scheming, said Gary Smith, president of the Ammonia Safety and Training Institute.

"We're really pushing hard to unify this idea of public safety, and when people go in their own directions, it really degrades the effectiveness of that plan," he said. "A shared color code means that first responders and safety training planners know immediately what they're dealing with in a facility."

ASTI's Smith emphasized that "muscle memory" is vital in emergency response. In many cases during an emergency situation, so many details need to be addressed simultaneously that any procedural details, such as differences in color coding from facility to facility, can create unnecessary delays for a first responder.

"If every facility has a different color scheme, that's not a good situation because the responder has to stop and re-calibrate," he said.

"If that common color scheme is already there, we can see quickly if we're dealing with a high or low pressure system problem. It helps us orient ourselves and gives us confidence to deal with the issues at hand."

The logic behind an agreed-upon guideline eliminates uncertainty, making a facility that much more prepared to deal with a potential emergency. "This is a major safety step that goes beyond individual interests," he said.

Hamilton agreed, pointing out that eliminating variance is a major benefit of common color scheming. "In everyday operations, but especially during emergency response, the more variance there is in a system, the more potential you have for something to go wrong. This is just one thing we can do to eliminate the level of variance we have to deal with in an emergency."

Despite the obvious safety benefits, the industry has been slow to adopt a common color guideline for reasons ranging from difficulty defining color itself to reluctance about moving away from the status quo.

Part of that reluctance stemmed from the fact that the industry already has a way to designate piping. Ammonia facilities have for many years followed guidance from the American National Standards Institute, which specifies the color of pipe labels, but not pipe colors.

"Our pipes already have pipe labels, so many companies didn't see the necessity of adopting an industry-wide color scheme, which involves an expensive and time consuming effort to paint pipes and install color jacketing on insulated pipes," said IIAR's Smith.

Nevertheless, as color coding proves itself to be an invaluable tool in technician training and emergency response, it has become much more common for facilities to adopt color schemes.

"More and more, facilities see color coding as an aid in training and emergency response," said Hamilton. "But there has been no consistency on color, so everyone has developed their own scheme."

And as facilities moved toward color coding, a patchwork of systems developed, said IIAR's Badger. "Everyone was looking for a standard system, but no one knew what it should be. "

The task of deciding what that system should be fell to the IIAR Piping Committee, which set out to write a guidance document that would specify pipe colors, but leave the door open for companies that were unable, or unwilling to leave their own color schemes, said Hamilton.

"During our committee meetings, we had many discussions about who was doing what, and how," he said. "A lot of what we had to do was work around different codes and find the colors that would integrate for the most part with what we already had as an industry."

However, identifying the most commonly used piping colors turned out to be a small task compared with finding a way to describe them.

"The problem we quickly realized we had was that we couldn't just refer to a general color," said Hamilton. "We needed a way to specify the exact color that should be used on a pipe or insulated pipe jacket."

He added that IIAR's Smith was the group member that finally provided a breakthrough by suggesting that the piping committee use Pantone color standards to specify exact colors.

"We noticed that ANSI standards for safety color coding referenced specific Pantone colors, and that

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provided an example for us to follow," said Smith. "Then the committee got together and discussed what was most commonly seen in the industry as well as what colors were available from PVC pipe jacket and marker manufacturers, and assigned Pantone values to represent those colors."

The result was a document that will be meant to provide "a color scheming guideline for machinery rooms," said Hamilton.

The guidance will be published as an update to IIAR Bulletin 114, because the bulletin already addresses piping by giving labeling guidance, said Smith, adding that the updated bulletin will also reflect an ANSI labeling change.

ANSI 13.1, which was used as a reference when IIAR Bulletin 114 was originally developed, recently changed its recommendation for label background colors for toxic and corrosive materials from safety yellow to safety orange.

"This labeling language will also be incorporated into Bulletin 114 when it is republished," said Smith. "The point is to bring labeling and informal pipe color guidance into line with what's going on in the industry."

As with any change, concerns surrounding the reaction of regulatory agencies to an industry-wide consensus have been a part of the color coding debate ever since it began, more than ten years ago.

Many in the ammonia refrigeration world were skeptical that agencies like OSHA would view a color-coding consensus as the informal guidance it is ultimately meant to be, said Smith.

"With most recommendations, there's the concern that the information could become codified or standardized," said Hamilton. "It would be an expensive requirement if a facility suddenly had to repaint all of its pipes."

But the goal of the guidance – to find cohesiveness in the industry – is much more likely to be viewed by OSHA as an ongoing effort, not the basis for a sudden regulatory change, said IIAR Director of Government Affairs, Lowell Randel.

However, he cautioned, any facility making a gradual change to a new color scheme should take extra care to make sure that its transition is thoroughly understood by facility personnel and that there are good training measures in place.

"Obviously, OSHA looks at standards, but it also recognizes best practices within an industry," he said. "This guidance

A Guide to Bulletin 114: Piping Colors

In its updated form, IIAR Bulletin 114 will provide a method for expanding color identification guidelines, and will serve as a recommendation for an expanded piping color scheme.

The guideline will address: un-insulated line finishes; insulated lines with insulation jacketing; and intermittent markers. The colors specified by the guideline have been designated by Pantone color numbers, from the Pantone Color Matching System, and are identified by the document as "targets" for shade, tone, and color.

The bulletin makes an allowance for slight variations that are expected as a result of variance in manufacturing, UV deterioration, dust and other unforeseen factors that may alter the appearance of color either at installation or after the jacketing or markers have been in service.

According to the draft bulletin, facilities may select an alternate color scheme as long as that color scheme is consistent throughout a facility. Regardless of the color scheme selected, Bulletin 114 specifies that a legend or key to the meaning of the colors should be posted in a conspicuous area. Listed below are the eight Pantone colors recommended under IIAR's piping color scheme, which is slated for release as an update to IIAR Bulletin 114 early next year.

High Pressure Liquid Piping

Ammonia high pressure liquid piping should be **Ammonia Refrigeration Orange (PANTONE® Color 152 C)** for services > 70 psig as follows:

- High Pressure Liquid (HPL)
- Sub Cooled Liquid (SCL)
- Thermosyphon Supply (TSS)
- Thermosyphon Return (TSR)
- Condenser Drain (CD)
- Liquid Injection Cooling (LIC)
- Intermediate Pressure Liquid (IPL)

Ammonia High Pressure Vapor Piping

Ammonia high pressure vapor piping should be **Ammonia Refrigeration Yellow (PANTONE® Color 109 C)** for services > 70 psig as follows:

- Booster Discharge (BD)
- High Stage Discharge (HSD)
- Hot Gas Defrost (HGD)
- Foul Gas (FG)

Low Pressure, High Temperature Liquid and Vapor Piping

Low pressure, high temperature liquid and vapor piping should be **Ammonia Refrigeration Light Blue (PANTONE® Color 298C)** for the services within the 0°F to +45°F range (saturated pressure 66.3 psig>P>15.7 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low pressure, high temperature range are as follows:

- High Temperature Recirculated Liquid (HTRL)
- Booster Suction (BS)
- Economizer Suction (ES)
- High Stage Suction (HSS)
- Medium Temperature Suction (MTS)
- Medium Temperature Recirculated Suction (MTRS)
- High Temperature Suction (HTS)
- High Temperature Recirculated Suction (HTRS)
- Defrost Relief (DR)

Low Pressure, Low Temperature Liquid and Vapor Piping

Low pressure, low temperature liquid and vapor piping should be **Ammonia Refrigeration Dark Blue (PANTONE® Color 3015c)** for the services within the -1°F to -20°F range (saturated pressure 15.7 psig>P>3.6 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low pressure, low temperature range are as follows:

- Low Temperature Recirculated Suction (LTRS)
- Low Temperature Recirculated Liquid (LTRL)
- Low Temperature Suction (LTS)
- Low Temperature Liquid(LTL)

Low Pressure, Low-Low Temperature Liquid and Vapor Piping

Low pressure, low-low temperature liquid and vapor piping should be **Ammonia Refrigeration Purple (PANTONE® Color 2617 C)** for the services within the -21°F to -60°F range (saturated pressure P< 3.6 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low Pressure, low-low temperature range are as follows:

- Low-Low Temperature Recirculated Suction (LLTRS)
- Low-Low Temperature Recirculated Liquid (LLTRL)
- Low-Low Temperature Suction (LLTS)
- Low-Low Temperature Liquid(LLTL)

Non-Pressurized Refrigeration Piping and Related Process Piping:

Pressure Relief Vent Grey (PANTONE® Color 430 C) for:

- Pressure Relief Vent Piping (RV)

Water Green (PANTONE® Color 3415 C) for:

- Water Piping

Sprinkler Red (PANTONE® 485 C) for:

- Fire Sprinkler Piping

is something that regulatory agencies will ultimately look at, but as long as a facility is consistent in how it trains its personnel and how it is implementing its color policy, it should be okay from a regulatory perspective."

"Anytime you can improve consistency, remove variability and increase the application of a best practice, whatever that may be, the better off you will be as an industry in the eyes of OSHA and EPA," said Randel.

The guideline may draw some OSHA attention to color coding practices, but any company with a good system shouldn't be worried, said Marrella.

"It's way too early for OSHA and EPA to say that this represents a generally accepted practice. It's going to take years before that is a concern," he said. "This is a new recommendation and it will happen over time."

Indeed, many involved in the color coding debate say they see a slow transition that will last for many years, but will ultimately result in the uniform color code being used across the industry.

"As new facilities come online, they will adopt this convention, and everyone else will integrate it eventually," said IIAR's Rule. "We don't expect that companies will make these changes all at once. Now that this is a consensus and its part of the mainstream, it will be something our industry gravitates to over time."

While it may take some time for the industry as a whole to orient itself when it comes to color, some companies may move fast to make the change.

Jeremy Corselli of Rancho Cold Storage said he plans to make the transition at his facilities as soon as the guidance is released.

"I've always wanted a standard for color codes, ever since I started my career," he said. "It's a great relief that engineers coming into this industry ten or twenty years from now won't even be aware that this was ever an issue."

"It's really a monumental step for all of us to release this guidance," said Hamilton. "We've been debating this issue for a long time, and now we can finally move forward." ■

Where's that vapor going?

BY KEM RUSSELL

Where's that vapor going? Sooner or later that question must be answered when some type of work is required on an ammonia refrigeration system.

To accomplish the work, the system may have to be opened, and later that portion of the system pressure tested.

The pressure testing process will typically involve some amount of ammonia used in the final test, after which the pressure is removed again before the portion of the system tested is placed back into operation.

Even when a small amount of vapor is vented to atmosphere, several seemingly innocuous details can add up to a big problem if they aren't carefully considered.

In this edition of "Lesson Learned," we'll look at a specific case where those details were overlooked.

It was a routine day and a routine procedure that took the contractor in this case to the facility roof.

In this instance, pressure was applied to the piping associated with a newly installed automatic purger. After installation of the new purger, solenoids at several condenser connection points, and all of the associated piping, a pressure test was done.

The majority of the new valve assemblies and piping was located up near the evaporative condensers, which were mounted above the machine room.

The only new equipment and piping in the machine room was for the purger. The distance from the ground level outside of the machine room to the condensers located directly above the machine room was approximately 35 to 40 feet.

The contractor doing this work knew he was well above ground level and above the roof level.

He also knew that there was not much ammonia vapor to release due to the volume of small size piping and only one circuit of one condenser.

The contractor estimated that the location and the small vapor volume of the ammonia in question would make the decision to vent the ammonia pressure to atmosphere a sound choice.

With the pressure test successfully completed, it only took a few minutes to release the ammonia pressure.

Up to this point things had been uneventful, however, one important detail had not been considered. Where is that ammonia vapor going?

Many times, even normal wind flow can be affected by building structures and other natural barriers such as trees.

As the wind hits these objects, it can create eddies or other temporary changes of wind direction, pushing vapor in unexpected directions.

Up to this point things had been uneventful, however, one important detail had not been considered. Where is that ammonia vapor going?

In this particular case, not only were there building structures, but the prevailing wind was not coming from the normal direction. As the ammonia vapor released, it was quickly taken over the roof of the building where the condensers were mounted, across an alley between buildings, and then, due to an eddy effect, pushed to ground level beyond the next building.

As the vapor went to ground level, it also spread out and traveled through a group of construction workers in the nearby area.

Even though the amount of vapor released was well below the federal reporting quantity of 100 pounds in 24 hours, it was sufficient to cause the workers in the impact area to feel very uncomfortable.

The smell of ammonia was quickly reported to the facility personnel, even as the vapor rapidly dissipated due to the small amount released.

So what lessons were learned from this event?

Probably the first and most obvious one is to make sure you know what direction the wind is blowing before blowing off the vapor. As in this case, it would be wise to not only check the wind direction at the release location but also downstream where there may be eddy effects.

Another important consideration that should have been made before the contractor got to this point in his work is the facility emergency plan.

A contractor must understand what to do if there is an emergency, and

he should also know what to do and who to call if he causes the emergency.

Along with this, prior to releasing ammonia, the contractor and facility personnel should coordinate as best they can to determine any potential negative impacts to people and the environment.

This coordination should involve making sure there are no downwind concerns, such as people, in this case, that could be affected. With this analysis, the means and method of release would be adjusted to eliminate potential unwanted impacts.

In thinking about releasing pressure, a determination should be made on whether to release the pressure to atmosphere, or purge into water, or use some other means to neutralize the released vapor.

These methods all have their place and can be very effective if the focus is not only on where the ammonia is coming out, but also on people and the environment in the immediate area, as well as further downwind.

If the decision is made to release to the atmosphere, knowing that ammonia is a natural part of our environment and will usually dissipate quickly, the release of the pressure should be done in a controlled fashion.

In this particular case, the purging valve used to release the pressure was opened quickly to rapidly dump the pressure.

A better approach would have been to partially open the valve and let the pressure slowly bleed down. A slow release would have allowed the vapor to thoroughly mix with the air and would have significantly reduced the downwind distance where a noticeable level of ammonia smell could have gone.

In this case, the lessons weren't over with the actual event. Staff at the facility itself also has a responsibility when an ammonia event occurs.

The question was asked in this example: "Was this a near miss since no one was injured or even affected that much?"

The answer is: No! It was a direct hit! And an incident investigation must be done in a case like this to not only find out what happened, but also to reduce or eliminate the possibility of it happening again.

In addition, just because this was a release that was well under the federal reporting quantity, it does not mean other agencies or groups don't need to be notified.

In the particular location, both the state emergency management division, and the local emergency planning committee were notified. The fire department may also need to be notified.

This event could easily have been a non-event if a few of the above mentioned thoughts had been considered.

Luckily, no one was injured and the lessons learned by both the contractor and the facility were valuable. Hopefully we all can learn from this example, and ask the important question –where's that vapor going? – sooner, rather than too late. ■

IIAR'S FIRST CENTRAL AMERICA CONFERENCE

HIGHLIGHTS INDUSTRY GROWTH

The International Institute of Ammonia Refrigeration held its first regional seminar for Central America and the Caribbean in Costa Rica last month, an event that marked the organization's increasing involvement in education and safety advocacy in Latin America.

IIAR leaders said the seminar attracted a record number of attendees, from eight different Latin American countries, and offered an unprecedented opportunity for the organization to work with industrial refrigeration groups inside Costa Rica.

Seminar participants said they attended the October 15-16 meeting in San Jose, Costa Rica, to take advantage of the education and networking opportunities in a region that is seeing an increased focus on industrial refrigeration.

In Central America, where, in many cases, government regulations and safety practices are evolving to keep pace with development, the time has never been better for IIAR to supply its extensive resources. And that need is especially clear in countries that have not been traditionally focused on ammonia refrigeration, said Ricardo Mardones, President and General Manager of Houston-based consultancy, RIMA Refrigeration.

"There are no standards that exist here [in Central America] that the industry can follow," added Mardones, "So there is a big emphasis on promoting and adopting the IIAR standards within this region. Everyone who does business here is aware that we need these standards to grow as an industry, and to grow safely."

Mardones was not the only U.S.-based IIAR member in attendance at the Costa Rica seminar. Large companies like GEA Refrigeration and Parker Hannifin are also looking south to new markets, and advocating the widespread adoption of IIAR's educational resources.

"There are many companies that are investing in this region now," said Mauricio Quiroga, Sales Manager for Mexico and Central America for GEA. "Where markets were once more closed, they are opening up to investment in ammonia refrigeration. That, in turn, is spurring the growth of industries that depend on our technology."

Growing demand for agricultural products that are traditionally exported from Central American countries and recent free-trade agreements are bolstering an expanding cold chain.

At the same time, several of those countries, newly minted as eco-tourism destinations, find themselves facing mounting pressure, either as a result of their involvement in agreements like the Montreal Protocol or from the expectations of their new tourist visitors, to find environmentally responsible cooling technologies.

"There are a lot of agricultural produce industries, like those that grow tropical fruits and vegetables that depend on industrial refrigeration," said Quiroga. "Those industries are growing, but we're more focused on ammonia refrigeration these days, not only because of that growth, but because there is a real emphasis on eliminating hydrocarbons in this region."

As HCFC-based facilities are increasingly replaced with ammonia refrigeration installations, safety will be a top priority for all involved, from small companies to government agencies.

And although Costa Rica is the only country in the region actively working with IIAR to develop and inform safety guidelines, smaller regional companies are already looking to IIAR to supply the resources they need as business grows and attracts government oversight.

Santiago Barraza, a seminar attendee from Panama said he was attending the IIAR event to get safety resources to pass on to his facility operators at an ice factory called Compañía Hielo Fiesta.

But, Barraza added, IIAR resources had already proven valuable to his company earlier this year, when a controlled evacuation of his facility aroused suspicion from neighbors.

"With the knowledge I obtained from IIAR, I was able to proceed to explain to the staff of the environmental department of Panama that a safe procedure based on IIAR information had been followed, and there were no more complications."

Federico Alarcón López, IIAR's marketing coordinator for Latin America, said there are two key reasons for companies and governments to collaborate with IIAR, and for IIAR to continue to organize events like the one in Costa Rica. "One of our main goals with this seminar was to explain the importance of designing safer refrigeration systems," he said.

Alarcón added that IIAR members at the seminar also sought to help people understand the importance of safety standards.

The Costa Rica seminar was a significant milestone for IIAR because it allowed the organization to take a region-specific approach to outreach. This marks a departure from previous IIAR seminars, which in the past have focused on specific countries.

Representatives from Costa Rica, Mexico, El Salvador, Honduras, Panama, Ecuador, Nicaragua and the Dominican Republic attended the event. Alarcón noted that "The whole region came together to hear about and implement new ideas that address common concerns."

Beyond safety and training, the other main goal of the seminar was to emphasize the connection between ammonia refrigeration and energy efficiency, Alarcón said.

In fact, helping other nations develop ammonia refrigeration standards is an important way for IIAR to expand its membership, Mardones said. "By emphasizing the importance of uniform standards, ammonia refrigeration can grow in a way that is both environmentally and economically beneficial to companies and regulators."

Another highlight of the seminar was a session related to IIAR's piping handbook. Chris Combs, IIAR's director of international programs, said the session focused on the importance of pipe sizing, an issue many seminar attendees found important.

Combs also praised the government of Costa Rica for taking an active interest in IIAR's priorities of education and safety.

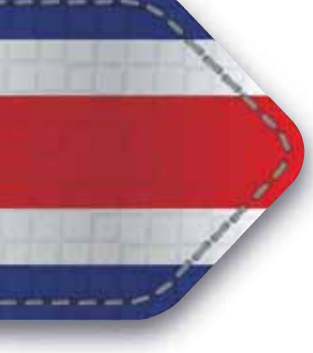
IIAR worked with INA, the National Institute of Learning, a Costa Rican government training organization to promote the seminar. That effort included a 40-minute interview with Mardones and Alarcón about the seminar during INA's regular program on a public radio station in Costa Rica, explained Combs.

"Thanks to a public-private partnership, INA has built an ammonia loop facility for training purposes," Combs added. "INA has a strong interest in expanding the knowledge base here in Costa Rica."

Besides INA, the other governmental organization that participated in the seminar was MINAET, the country's ministry of energy, telecommunications and the environment.

Costa Rica is the only country in Central America with a government agency specifically focused on ammonia refrigeration, said Mardones, adding that government involvement was one reason IIAR's event was so widely attended.

"Costa Rica is leading the way in this region, and the country could eventually serve as an example for Central America in general," he said. "Ammonia refrigeration is obviously the most viable solution here for many reasons, economic and environmental. That will create some very interesting opportunities for growth here, and that growth begins with events like this one." ■



Costa Rica Looks to Neighbors, IIAR, to Promote Natural Refrigerants in Central America

BY CHRIS COMBS

In 2013, the Costa Rican government began implementing its national strategy to eliminate hydrochloroflourocarbons while supporting IIAR's first Industrial Refrigeration seminar in Central America.

In a speech outlining the country's national strategy for the elimination of HCFCs, Dr. Elidier Vargas Castro, Deputy Director of Costa Rica's Ozone Technical Office, told IIAR members and seminar attendees that companies in Costa Rica now face a new quota for the importation of HCFC refrigerants and equipment.

MINAET has posed an ambitious challenge: to leapfrog over the intermediate stage of HFC and HFO use, transitioning directly to natural refrigerants. Dr. Vargas identified natural refrigerants suitable for most types of cooling including HC and NH3 in air-conditioning; CO2, NH3 and HC in commercial refrigeration; HCs in domestic refrigeration and air conditioning for cars, etc.

One important reason for the interest in jumping directly to the use of natural refrigerants in Costa Rica is the economic savings that eliminating the investment in HFC and HFO refrigerants, equipment and related knowledge would represent, given that the country recognizes that its goal is to transition to natural refrigerants in the long term because of their high energy efficiency and low GWP.

Costa Rica's National Strategy for the Elimination of HCFCs represents part of Costa Rica's international commitments and it fits in with the county's own goals and interests. Costa Rica signed the Montreal Protocol in 1991 and the directives of the Protocol have the weight of law in Costa Rica.

Since 1991 MINAET has received one million dollars in financial and technical support from the Multilateral Fund for the Implementation of the Montreal Protocol. MINAET used part of these funds to provide support to companies to upgrade their equipment.

MINAET said it regards the implementation of this program as part of a global initiative; however, to succeed it recognizes the importance of participation by other countries with more limited resources for investment.

For example, Vargas Castro noted there is resistance in neighboring Nicaragua due to the lack of financial support for transitioning to more environmentally sustainable refrigeration technologies. A successful amendment to the Montreal Protocol sponsored by the U.S., Mexico and Canada regarding HCFC reduction could possibly bring more support for developing countries and add momentum to the HCFC phase out curve in countries like Costa Rica.

MINAET hopes to see increasing support from developed countries towards the transition from HCFCs to natural refrigerants in developing countries.

Part of Costa Rica's vision for creating incentives for developing countries to adopt more environmentally friendly policies relates to the role that forests play in capturing carbon emissions: 25 percent of Costa Rica's territory consists of national parks and 50 percent of the country is covered by forests.

It hopes for the implementation of a mechanism in which polluting countries provide compensation for countries like Costa Rica that play an important role in capturing these emissions by preserving their forests.

Although support for the Montreal Protocol is strong globally, there is no comparable effort to Costa Rica's program for phasing out HCFCs in other Central American countries.

In the absence of such programs, largely due to financial and other barriers found in the other countries of the region, Vargas Castro said the short term priority should be to convince companies with the resources to do so to invest in this transition.

Both the cold chain and other growing sectors of Costa Rica's economy highlight the need for investment in new environmentally friendly HVAC-R technologies.

Providing the knowledge necessary for the transition from HCFCs to natural refrigerants to technicians and other industry professionals is a key part of MINAET's refrigerants program. For this reason, MINAET has cultivated a strong relationship with Costa Rica's National Institute of Learning, or INA, universities and professional schools, as well as other educational and training entities.

Beginning with its involvement in the IIAR seminar in Costa Rica, MINAET said it will collaborate with organizations like IIAR to develop technician-training standards, basic education, renovate curriculums for new technologies and apply installation and safety standards to eliminate risks and accidents in the industry.

MINAET said it would also like to collaborate with international organizations and the Costa Rican Accreditation Entity, or ECA, in setting up an accreditation program for refrigeration technicians.

According to Dr. Vargas, MINAET chose to participate in IIAR's regional seminar because it views ammonia is a positive alternative for the future and because it hopes to work with IIAR to train technicians.

He stated that events like IIAR's benefit the entire Central America region as Costa Rican technicians work in other countries of the region as well.

Vargas Castro added that without the participation of a larger number of countries, there is more resistance to efforts like the initiative in Costa Rica. "The more participants we have, the easier it is to make progress," he said. ■

As a member of IIAR you join with over 2,000 individuals in more than 30 countries who share your enthusiasm to your career and profession. Strength in numbers helps us make a positive difference!

What's new with IIAR...

Announcing New IIAR Website Launch! We are very excited to have finally launched the new IIAR website! This site will allow our members to have better functionality and more access to content and information. If you have not done so already, please visit us at www.iiar.org and check it out. As a work in progress, the IIAR website will expand with our membership as we add more layers and better depth to compliment the enhanced user experience. IIAR will be migrating all of the content from the old site to the new site and we appreciate your patience and understanding as this occurs. If you have an idea for a page or topic that you would like to see, please let us know. Your feedback and input are valuable.

First IIAR Webinar – In September IIAR launched its first in a brand new series of webinars entitled *Recent Trends in OSHA Inspections*, presented by Lowell Randel, Director of Government Relations at IIAR. This well-attended and well-received event presented how OSHA's enforcement activities have intensified over the last few years and covered OSHA-wide inspection data, as well as detailed information regarding the findings from the first full year of the National Emphasis Program for Chemical Facilities and how IIAR members can be better prepared for when OSHA knocks on their door.

New IIAR Video – *Ammonia, The Natural Refrigerant of Choice* has been released! Highlighting the importance of ammonia as the premier natural refrigerant, this video contains informative industry information from some of the top minds in the field. Available in Spanish.

What's on the horizon for IIAR...

The 2014 Industrial Refrigeration Conference & Heavy Equipment Show March 23 – March 26, 2014 in Nashville, TN. Join your colleagues and industry friends to discuss the hottest topics in industry trends and view the latest in cutting edge refrigeration equipment.

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Location The 2014 IIAR Industrial Refrigeration Conference & Heavy Equipment Show will be held in Nashville, TN at The Renaissance Nashville Hotel & Convention Center. The Renaissance Nashville Hotel is located in the heart of downtown Nashville with easy access to popular attractions like Robert's Western World, Tootsies, The Country Music Hall of Fame, and the Ryman Auditorium. A downtown luxury hotel in Nashville, TN, the Renaissance Nashville Hotel & Convention Center is an ideal destination for meetings and conventions.

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If you have any questions please contact IIAR at **IIAR_Request@iiar.org** or **703-312-4200**.
If you would like to exhibit at the 2014 IIAR Industrial Refrigeration Conference & Heavy Equipment Show please contact Eileen McKeown at **eileen_mckeown@iiar.org**.

2014 Industrial Refrigeration Conference & Heavy Equipment Show Program

On Sunday March 23, IIAR will host two preliminary conference programs:

The IIAR PSM and RMP Workshop

This workshop introduces IIAR's model PSM/RMP Program and presents strategies for implementing it in your facilities. In addition, the workshop will discuss how to conduct effective audits for regulatory compliance. The program concludes with a discussion of PSM/RMP typical program weaknesses that are consistently arising as a result of regulatory inspections as part of OSHA's National Emphasis Program. The workshop provides you with the latest information on regulatory activity associated with the issuance of the President's Executive Order: "Improving Chemical Facility Safety and Security" in August of 2013. This workshop will:

- Enable you to significantly enhance the safety of your ammonia covered processes
- Provide you with information to perform effective audits to ensure your PSM/RMP program is in regulatory compliance
- Help you avoid common pitfalls that are leading to non compliance discovered during NEP inspections

1:00 p.m. – 5:00 p.m.
Workshop Fee: $250.00

Ammonia Safety Training Day

Presented by the Ammonia Safety Training Institute (ASTI) in conjunction with IIAR exclusively for the 2014 IIAR Industrial Refrigeration Conference & Heavy Equipment Show, this half day workshop is intended for, but is not limited to, end-users and facility personnel who create policy for and respond to ammonia releases and accidents, first responders, and emergency personnel. Anyone interested in ammonia safety with regard to Industrial Refrigeration may attend. This training workshop covers topics including best practices in safety readiness, most effective PPE choices, and general hazards of storage and use of ammonia. It will incorporate PSM/RMP information in regard to first response policies.

8:00 a.m. – 12:00 p.m.
Workshop Fee: FREE

The IIAR Technical Program

The acclaimed IIAR Technical Program includes rigorously peer reviewed technical papers, experiential workshops, and engaging panels. PDH and CEUs are given to industry professionals for attendance at the technical paper presentation sessions and workshop sessions. This year the IIAR Technical Program includes topics ranging from relief header release modeling, reduced requirements for PPE, to small charge systems and beyond…

The IIAR Exhibit Hall Floor

Held only once every three years, the IIAR Heavy Equipment Show affords the unique opportunity to see, touch and ask in depth questions about equipment that is currently being used in the field as well as preview the newest product developments coming to market.

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Routine Rooftop Maintenance Creates Requirement for Fixed Industrial Stairs

Increased regulatory scrutiny and the growing emphasis on process safety management have spurred a steady relocation of equipment from production room floors, freezers and coolers to facility rooftops. The reasons for the transition have been practical. Moving equipment to a roof allows a facility to expand by taking advantage of the "free real estate" offered by a building's rooftop footprint. And safety benefits – like eliminating the potential for pipes to be struck by handling equipment or minimizing exposure – limit liability in an era marked by federal oversight initiatives like OSHA's national emphasis program.

While facilities may be doing everything right when it comes to moving equipment to the roof, they may be overlooking a seemingly innocuous detail that OSHA has begun to focus on: the methods of egress.

When equipment on a roof requires any kind of routine maintenance, fixed industrial ladders, which have commonly been used by the industry to provide access to the roof, are no longer sufficient.

And in most cases, relocation of equipment to a rooftop has created the need for routine maintenance, leaving facilities that have only fixed ladders vulnerable to OSHA citations.

"We've always had equipment on the roof, but in the past, it hasn't been equipment that requires routine maintenance," said Bryan Haywood, PSM consultant and president of the Safety Engineering Network. "Now that equipment on the roof has grown in volume and complexity, the situation is different. IIAR and every RAGAGAP out there require that routine maintenance be performed, so the question becomes: how do you configure stairs and ladders to accommodate that maintenance?"

OSHA's answer, it appears, is simple: where routine maintenance is required, so are fixed industrial stairs.

"Most people know that fixed industrial stairs are a good idea, but not many people know that there is an OSHA standard that actually requires them," said Peter Jordan, president of MBD Risk Management Services. "If you have personnel on that roof once a day, you'd have a hard time reading the OSHA standard and saying you don't need fixed stairs."

"The bottom line is that if you have equipment on the roof that requires routine maintenance, OSHA is paying attention to this issue. They're going to see it."

The issue of egress is most likely to come up with OSHA during a routine PSM inspection, and, ironically, the relocation of equipment to the rooftop – which in turn creates a requirement for fixed stairs – is most often driven by a desire to meet a PSM program. However, the OSHA standard that requires fixed industrial stairs is not a PSM requirement.

"The citations we're seeing from OSHA are not being made under PSM, they are made under 1910.24(b), the agency's standard for industrial stairs," said Haywood.

To better understand what this may mean to a facility, Haywood suggested a thorough study of standard 1910.24 "Fixed Industrial Stairs," and its requirements, as follows:

1910.24(b) states…

"Where fixed stairs are required." Fixed stairs shall be provided for access from one structure level to another where operations necessitate regular travel between levels, and for access to operating platforms at any equipment which requires attention routinely during operations.

"As you can see, it is pretty clear that a process that places its piping and other components that require attention routinely during operations on a roof will be required to have fixed industrial stairs for access to their roof areas," said Haywood, adding that if the first portion of the section is not convincing enough, the second part provides more examples of when fixed industrial stairs are required…

Fixed stairs shall also be provided where access to elevations is daily or at each shift for such purposes as gauging, inspection, regular maintenance, etc., where such work may expose employees to acids, caustics, gases, or other harmful substances, or for which purposes the carrying of tools or equipment by hand is normally required. (It is not the intent of this section to preclude the use of fixed ladders for access to elevated tanks, towers, and similar structures, overhead traveling cranes, etc., where the use of fixed ladders is common practice.)

"I am sure someone could argue at some point that their processes do not meet any of these requirements," said Haywood. "However, if your facility has daily or shift rounds to be made (normal practice in PSM/RMP processes) we need industrial stairs to access the roof. Even if we do not make daily or shift rounds, but workers have to go up on the roof to operate valves or perform maintenance on a regular basis, then we are required to have fixed industrial stairs."

Haywood also pointed out that 1910.37 requirements come into play . . .

1910.37(a)(3) Exit routes must be free and unobstructed. No materials or equipment may be placed, either permanently or temporarily, within the exit route. The exit access must not go through a room that can be locked, such as a bathroom, to reach an exit or exit discharge, nor may it

continued on page 32

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lead into a dead-end corridor. Stairs or a ramp must be provided where the exit route is not substantially level.

Fixed ladders that meet 1910.27 may be used for "emergency egress" in some situations, said Haywood, who added that he refers to OSHA's Standard Directive "STD 01-01-012 - Application of 29 CFR 1910.27, Fixed Ladders Used in Emergency Situations (6/20/1983)" to help explain when fixed ladders can be used as a means for emergency egress. In that directive, OSHA states…

This instruction provides performance criteria for fixed ladders used only as a means of access for fire fighters and other emergency personnel, or escape for employees in fire and other emergency situations.

1. *Employers must establish and implement adequate administrative controls such as barricades and signs to prevent nonemergency use of fixed ladders which are meant for fire fighter use and emergency escape only.*
2. *In the event the employer does not provide adequate administrative controls such as barricades or signs and employees use an emergency ladder for other than its intended purpose, the employer may be appropriately cited under 29 CFR 1910.27.*
3. *Fixed ladders not equipped with cages, landing platforms, ladder safety devices, or other forms of employee protection, in some situations may be allowed as a means of access for fire fighters and other emergency personnel, or escape for employees in fire and other emergency situations. These guidelines are provided because it may be more hazardous to comply with 29 CFR 1910.27 than not to comply.*

Regardless of where and how specific OSHA regulations surrounding stairs apply to an individual facility, the bottom line is that fixed stairs are almost always required when a large volume of equipment is on the roof, said Haywood.

"Moving equipment to the rooftop is safer for our equipment, but it also increases the risks to the workers who have to routinely access the equipment and perform high-risk activities with limited means of egress. Emergency egress is nothing to sneeze at, and it becomes doubly important when we have workers on a rooftop with highly hazardous chemicals."

And that, he said, should be the biggest consideration for a business that is considering moving equipment to a roof, or already has equipment in place. "If they've made this change, or if they're thinking about making this change, they may need to revisit their project in light of the OSHA requirement to ensure they have not created an egress issue," he said. ■

OSHA

Agency Issues Clarification on Hydrostatic Relief

The International Institute of Ammonia Refrigeration recently received clarification from the Occupational Safety and Health Administration on an ongoing question surrounding OSHA's requirement for hydrostatic relief for various pieces of equipment, especially evaporative condensers.

The issue was originally represented in an OSHA statement known as "the Palmer letter" which stated OSHA's position that hydrostatic relief is required when equipment containing liquid refrigerant can be isolated.

However, a few years ago, the agency unofficially noted that administrative controls, i.e. the use of trained operators, are acceptable when isolating equipment as outlined in IIAR-2. Nevertheless, OSHA did not officially revise its position and the interpretation remained on the agency's website.

The inconsistency created confusion about OSHA's requirement, and IIAR pursued OSHA to encourage the agency to make an official decision on the issue.

As a result of IIAR's communication on the subject, OSHA issued a notification that it will remove its requirement for hydrostatic relief, provided that administrative controls are used for isolation, as outlined in IIAR-2.

OSHA's decision to remove the requirement was an important recognition of the relevance of IIAR standards to the industry and the agency, said IIAR's Government Relations Director, Lowell Randel.

"This is a great example of how IIAR has been working with OSHA to inform them of IIAR standards and influence policy where standards are addressed by the agency," said Randel. "OSHA's response to IIAR highlights what the change means as far as how it applies to our standards, and showcases the proactive work that IIAR is doing with the agency."

Randel added that the collaboration represents an effort by IIAR to work with OSHA to inform the agency of IIAR standards and influence policy where those standards are addressed.

"This is a success story for both OSHA and IIAR where IIAR was able to go directly to OSHA and explain issues the industry had with an official interpretation. Now we've seen direct changes as a result of that back and forth communication," he said. "Because we've been able to develop good relationships with OSHA, we can discuss these kinds of issues and come to a resolution."

The technical details behind OSHA's notification on this issue are discussed in greater length in the "Technical Department" column in this issue of the Condenser. OSHA's notification and its current interpretation of requirements can be found on the IIAR website at www.iiar.org. ■

EPA Looks to IIAR in HFC Phase-Down Meeting

The search for non-ozone-depleting technologies is intensifying, with ammonia and other natural refrigerants emerging as the most viable solutions for industrial refrigeration, thanks to international treaties that put pressure on countries to phase down CFC's and identify alternatives.

As a result, the ammonia refrigeration industry in the United States is getting more attention from the Environmental Protection Agency, which is tasked with identifying substitutes for ozone-depleting substances under a program called the Significant New Alternatives Policy, or SNAP.

The EPA recently invited IIAR to participate in a SNAP industry stakeholder meeting where the agency said it will be looking for new ways to promote the growth of HCF-alternative technologies such as ammonia refrigeration.

In a question and answer session reprinted below, the EPA addresses the significance of the program as a response to U.S. involvement in the Montreal Protocol and the growing role it hopes IIAR and other industry organizations will take in promoting ammonia refrigeration and other natural refrigerants.

Q *Why did the EPA identify ammonia refrigeration as a viable green technology that could be used to accelerate the scale down of HFCs?*

A Even at the beginning of the SNAP program in 1994, EPA recognized ammonia as an acceptable refrigerant in new equipment in a number of uses. EPA's initial rule setting up the SNAP program said, "Ammonia does not deplete the ozone or contribute to global warming."

Q *What role does the EPA see the ammonia refrigeration industry playing in the effort to scale down HFC's?*

A Ammonia is already playing a valuable role by providing an energy-efficient refrigerant with no global warming potential or ozone depletion potential that is used in industrial refrigeration and cold storage warehouses. If ammonia becomes more widely used in appropriate retail food refrigeration applications, those benefits could extend more broadly.

Q *What can our industry do, or what are we doing, from the perspective of the EPA to accelerate the adoption of existing green technologies like ammonia and other natural refrigerants?*

A We encourage continued information sharing across industry about the benefits and about best practices for installation, servicing, repair and disposal of equipment using ammonia as a refrigerant. Sharing information with the retail food refrigeration industry, working with standard-setting bodies and keeping local code officials informed are all things the industry can continue to do.

Q *What is the role of the Montreal Protocol in relation to the SNAP Program?*

A The SNAP Program was established under Section 612 of the Clean Air Act as part of the U.S.'s response to the Montreal Protocol. It focuses on finding substitutes for ozone-depleting substances that would reduce overall risks to human health and the environment.

SNAP is the only major national program worldwide for evaluating the health and environmental risks of substitutes for ozone-depleting substances. Parties to the Montreal Protocol often consider decisions made by this program in their own decision-making process.

Q *Did the recent amendment to the Protocol that was set forth by North America and China accelerate the work of the EPA with regard to the SNAP program?*

A North America's proposed amendment to the Protocol to reduce production and import of hydrofluorocarbons, or HFCs, among other things, has encouraged chemical and equipment manufacturers to create and adopt more substitutes with lower global warming potential. Thus, the SNAP program has seen a large increase in the number of submissions of information on substitutes in the past several years.

Q *What benefit does the EPA hope to see from the engagement of the International Institute of Ammonia Refrigeration in the SNAP stakeholder meetings?*

A EPA hopes to continue its engagement with IIAR, both in the context of the SNAP stakeholder meetings and more broadly in the future. ■

IIAR Issues Call for Technical Papers

IIAR is currently requesting proposals for the industry's best technical papers.

Abstracts that address any topic related to ammonia and other natural refrigerants are welcome. However, papers that address specific topics will receive preferential consideration.

For a technical paper to be considered by IIAR for publication at the IIAR Annual Conference or in the Condenser Magazine, a paper proposal must be submitted and should include a 150 to 200 word abstract as well as a 50 to 75 word description of the practical applications of the paper's proposed contents.

All IIAR technical papers chosen for development will be submitted to a comprehensive peer review process.

Contact information such as name, address, telephone and fax number should be submitted with each author's proposal. Submissions may be made via email to: andrea_fischer@iiar.org, attention: IIAR Director of Communications.

Once a paper is chosen, IIAR offers each primary author a complimentary registration for the upcoming IIAR conference and publication in the Condenser. Every year, the two highest rated presentations receive the Andy Ammonia award, while the primary author of both papers receive complementary registrations for the following year's IIAR conference.

Remembering Don Siller

Whether it was helping friends, family, and colleagues or advancing the interests of the International Institute of Ammonia Refrigeration, people who knew Don Siller described him as someone who was passionate about life.

Siller was the president of Electro Motion Refrigeration, and a longtime member of IIAR, serving as an officer, board member and committee chair throughout his career in industrial refrigeration, which spanned more than forty years. Siller also held leadership roles at ASHRAE and participated on many ASHRAE committees.

"A great mentor, teacher and friend whose smile, laugh and always wise counsel will be truly missed."

As an IIAR member, he served on the organization's board during a critical time in the Institute's history. "Don was instrumental in spearheading IIAR's growth from a small group of ammonia refrigeration professionals into the large, respected international association that it is today," said M. Kent Anderson, a close personal friend and former IIAR President Emeritus.

"He was one of those rare individuals a volunteer-based association needs to be a success, and the kind of person you wish there were more of in any organization," Anderson said.

Jamie Horton, principal at EMR, said he was always amazed by Siller's commitment to IIAR, especially given his busy schedule.

"There were so many instances where Don made IIAR a priority over his personal time," said Horton. "This type of dedication to a volunteer organization is unique and shows how much Don cared about the success of the group and the industry as a whole."

Horton said Siller's teaching abilities were critical in helping him understand the intricacies of ammonia refrigeration throughout a 20-year friendship and during the six years the two men worked together at EMR.

"Don was dedicated to passing on his knowledge of industrial refrigeration to me. He always took the time to make sure I fully understood a technical issue and his experiences with the application," he said.

That's a sentiment echoed by current IIAR Chairman Bob Port, who also knew Siller well and considered him a mentor.

"I learned the whole ammonia refrigeration system from Don," said Port, who recalled his first project involving ammonia refrigeration. "Three days before I had to orchestrate an entire system shut-down; Don walked me through everything detail by detail. It was like ammonia refrigeration 101."

Port, who had had no prior experience with ammonia refrigeration at the time, was introduced to Siller by his father, who was also a close friend.

After the project was over, said Port, "we sat in his office and had a debriefing." And from there, Siller was always the person to turn to for technical advice.

"He taught me the technology, and I gained the hands-on experience. That was the relationship we had for my first six years in the business. He was an incredible mentor."

Horton agreed with Port that Siller's patience as a mentor was matched only by his resilience when dealing with complicated tasks. "You knew that if he took on a task, it was going to be done with the highest level of professionalism and it was going to be done thoroughly."

Siller's attention to detail and his willingness to help people were two of the qualities that characterized him best, said Anderson.

"While Don often had more work than he could possibly complete, he was always able to set it aside so that he could be prepared, engaged and focused on completing the task at hand, whatever it was."

And that focus and dedication was something Siller always brought to organizations like IIAR, said Anderson.

Siller, who was an honorary life member of IIAR, "was a critical part of establishing the foundation on which the organization still stands today," Anderson said.

Meanwhile, many friends observed, Siller's professional and personal friendships often seemed to overlap.

What made him special was how he could turn business relationships into lifelong friendships, said Steve McLeod, president of Toronto-based Cimco Refrigeration. "He was a terrific contributor to our industry with his incredible enthusiasm and energy."

Doug Reindl, an engineering professor at the University of Wisconsin, knew Siller for nearly two decades and was always impressed by his passion for the ammonia refrigeration industry. "To me and many others, he was a great mentor, teacher and friend whose smile, laugh and always wise counsel will be truly missed." ■

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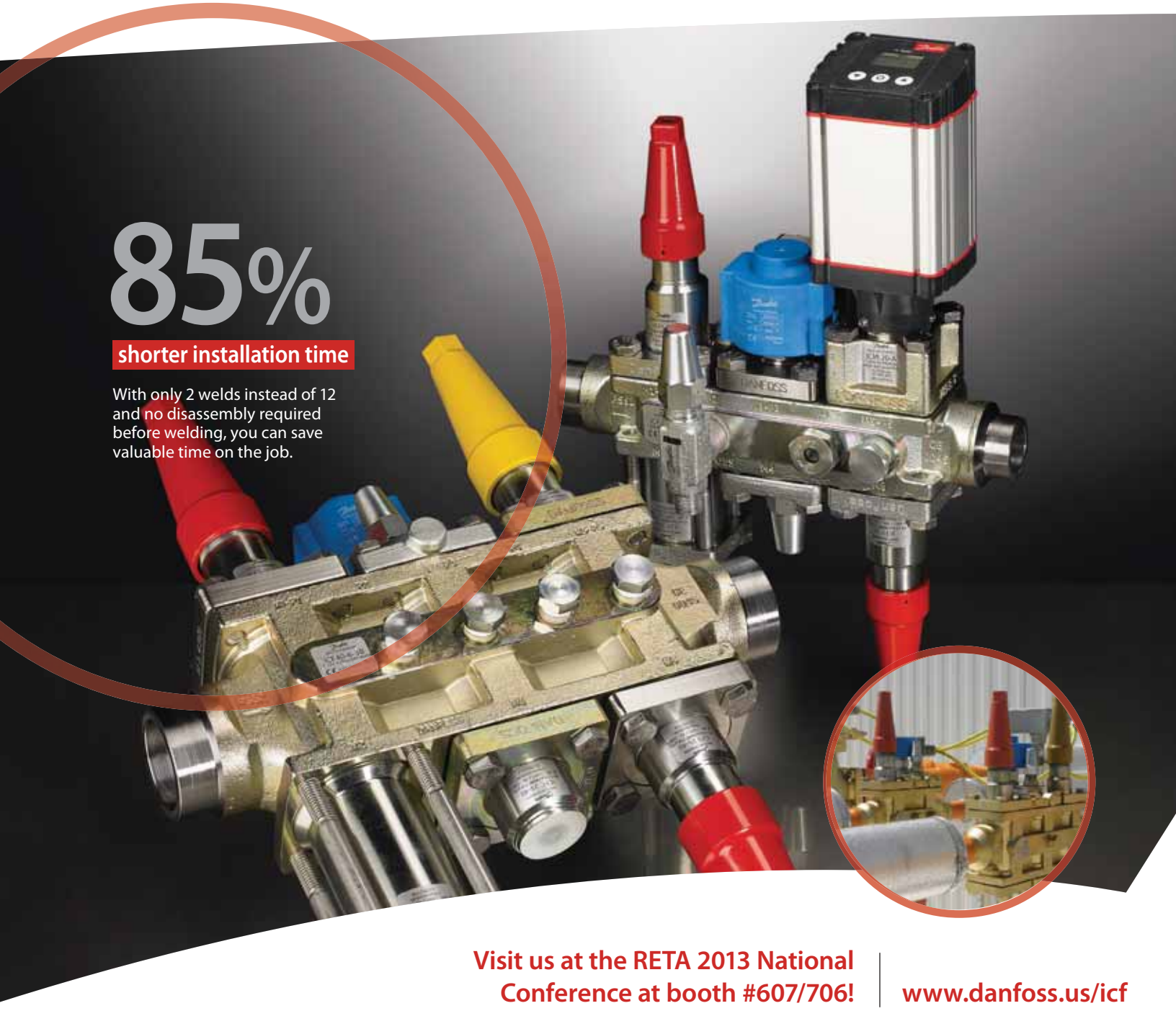

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IIAR Plans Training Collaboration

BY CHRIS COMBS, IIAR INTERNATIONAL PROGRAMS DIRECTOR

The IIAR International Committee has been hard at work on several important initiatives since it became a formal working committee in 2012. One of the group's most important goals in 2013 has been to facilitate training by conducting seminars and providing educational materials to governments and working groups in other countries.

The importance of ammonia refrigeration as an environmentally valuable technology has grown around the world, and with it, the importance of training.

As many countries look for ways to replace HFC's with natural refrigerants, they are also looking for ways to build the training and educational resources necessary to support the growth of what is, in many places, a relatively new industry.

And that training effort is as varied as the countries themselves. In some places, training is still close to non-existent, while in other places, governments have taken an active role in developing the resources necessary to turn out an experienced workforce of technicians and engineers.

One such country, Costa Rica, has made a significant investment in training through a publicly funded autonomous institution, called the National Learning Institute, or INA.

INA's mission, to provide training and professional development services with the goal of fostering productive work in every sector of Costa Rica's economy, fits with the environmental goals the country has set out to meet by training ammonia refrigeration professionals.

INA's Refrigeration and Air Conditioning program is part of an effort to develop energy efficiency that was set up through a Swiss - Costa Rican cooperation agreement.

Under the program, INA built an ammonia refrigeration training facility that was inaugurated and first used during the 2007-2008 academic year.

INA's facility has had a big impact in Costa Rica. So far, 100 students have benefited from hands-on training with an ammonia system and it has generated a passion for ammonia in Costa Rica's HVAC-R sector.

Former students of the program have also become involved in providing ammonia refrigeration training, and it has increased awareness of ammonia safety issues including personal protective equipment.

The importance of ammonia refrigeration as an environmentally valuable technology has grown around the world, and with it, the importance of training.

Meanwhile, the local industry has benefited from the availability of more knowledgeable technicians.

The facility is the first and only publicly-funded ammonia refrigeration training facility in Central America, and is important because it represents the kind of collaboration between private organizations and governments that can produce successful training efforts.

An example of a public-private partnership, the facility exists because private companies, including IIAR members, have provided or lent equipment, know-how and other forms of assistance, including demonstrations on the use of equipment.

Private companies like Refrigeración Industrial Beirute also facilitate efforts to keep the equipment up to date with the technology the industry uses today.

INA's Refrigeration and Air Conditioning technician training program is a two-and-a-half-year course. Potential students must pass a series of tests and an interview to be admitted to the program.

The first phase of the program lasts six to eight months and covers domestic air conditioning and refrigeration as well as thermodynamic theory.

The second phase also lasts six to eight months and covers commercial refrigeration and air conditioning. The final phase consists of one year of specialization in either industrial refrigeration or air conditioning and culminates in a practical internship at a company.

IIAR staff recently toured the refrigeration training facilities at INA's main campus in San José, where INA representative Wilberth Alvarado Marín outlined several potential areas for expanding the impact of the program.

These include developing agreements and exchanges with other countries in Central America that lack programs or facilities comparable to INA's refrigeration training center.

Nevertheless, while the program makes Costa Rica a leader in its region when it comes to ammonia refrigeration training, it lacks written educational materials.

That's exactly the kind of need that IIAR, through the International Committee is ready to meet. In the coming year, IIAR will work with INA to explore how IIAR materials could enrich the industrial refrigeration module of their refrigeration and air conditioning course.

The collaboration will certainly break new ground for training in Latin America, and may well serve as the best model yet for IIAR's training advocacy efforts around the world. ■

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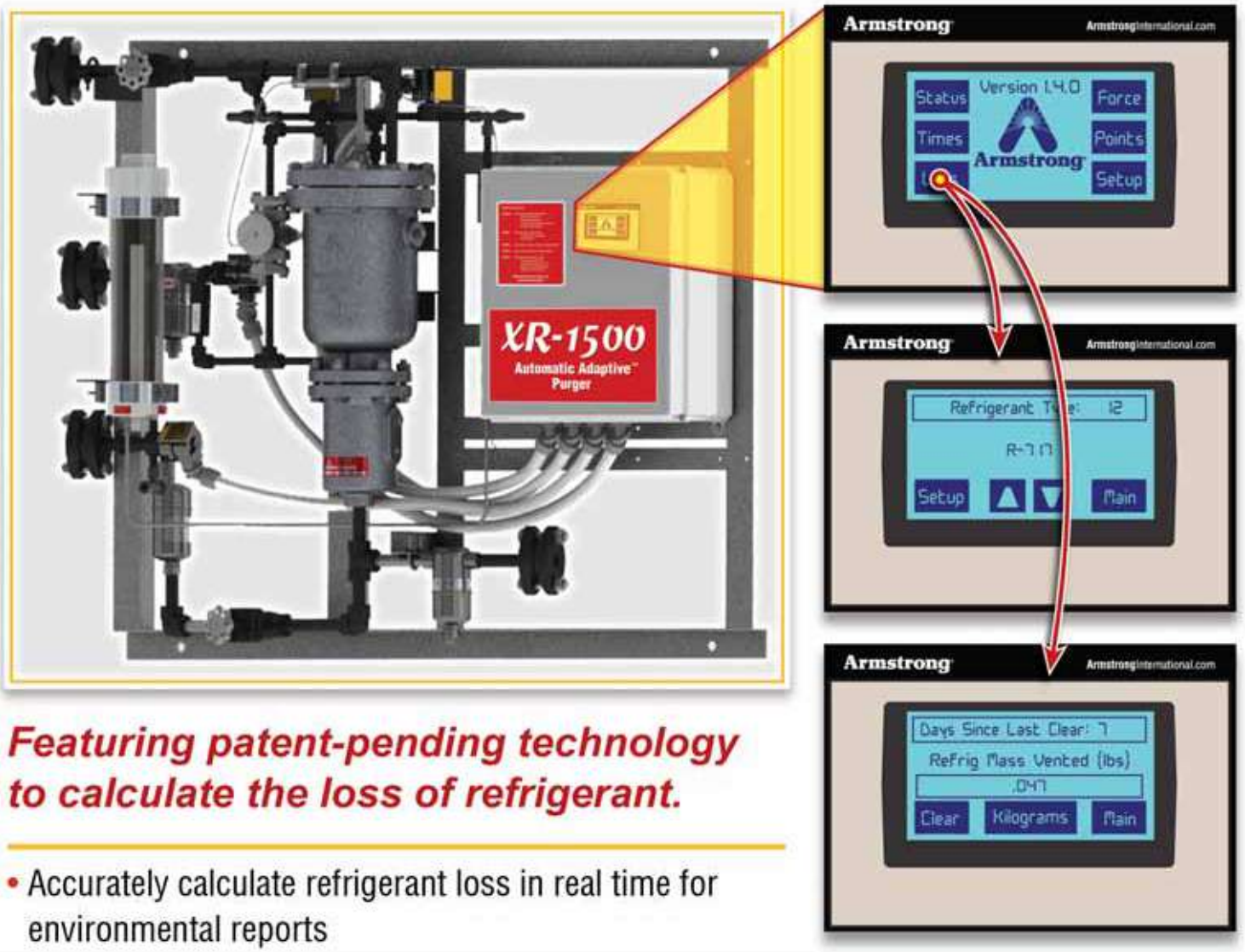

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Editor's Note

The technical paper, "The History of Fire Protection in Cold Storage Facilities" that appears in this section, is a summary of an IIAR workshop presented at the 2013 IIAR Industrial Conference and Exhibition, held in Colorado Springs, Colorado, March 17-20, 2013.

The purpose of this paper is to give an overview of fire protection in cold storage facilities by providing a detailed picture of the research and testing that has been carried out to describe such systems.

Cold storage facilities present unique environmental and operational challenges when it comes to fire protection, and systems used in non-cold storage warehousing applications may not be adequate measures of fire protection, according to the paper.

Conventional fire protection methods using in-rack sprinklers or long water delivery delays, for example, don't take into account the unique needs of a cold storage facility.

And in some places, certain devices can lead to damage, while the resulting system impairment can lead to a high maintenance price tag in the long term.

Nevertheless, until only a few years ago, the performance of conventional fire protection systems were not studied or tested extensively enough in the context of a refrigerated or frozen warehouse environment to yield the necessary information about appropriate design and installation.

That's a challenge fire protection engineering expert David LeBlanc set out to answer with testing and research.

The result of that testing, summarized by the paper printed in the following pages, demonstrates why the historical application of fire protection to warehousing is not the most effective application in cold storage environments.

The paper also illustrates the ways in which systems that have been designed to meet the unique challenges of these types of environments can achieve the objectives of providing greater fire protection while also addressing risks that can lead to operational issues down the road.

David LeBlanc is the Director of Innovation and New Ventures for Tyco Fire Protection Products. He holds a master's degree in fire protection engineering and has specialized in solving fire protection problems in storage facilities for over 15 years. LeBlanc's research on the issue of fire protection in the unique cold storage environment is ongoing, and has become an area of focus for Tyco Fire Protection Products.

THE HISTORY OF FIRE PROTECTION IN COLD STORAGE FACILITIES

By David LeBlanc

The protection of industrial cold storage warehouses is one of the most difficult challenges facing the fire protection professional. With facilities that can exceed 500,000 ft^2 and storage heights surpassing 40 ft, these structures represent severe fire protection problems even before considering the difficulty associated with the -30 °F temperatures that can be found in these areas. To further compound the problem, greater use of plastics in product packaging have pushed typical commodity classification for these facilities from Class II to Class III. Recently, new advances in fire suppression technology are allowing the application of highly engineered pre-action systems to permit the elimination of problematic in-rack sprinklers in these facilities Additionally, the method used to achieve this performance allows significant flexibility in the design of this system through the application of performance based design methods, allowing sprinkler systems to be truly engineered to meet performance objectives.

The default fire protection for cold storage remains double interlock pre-action control mode sprinklers, with in-rack sprinklers typically required when ceiling heights exceed certain thresholds. Fire detection is normally accomplished using conventional smoke or heat detectors, Linear Heat Detection (LHD) wire, or in some cases, aspirating smoke detectors. This approach has historically provided adequate fire suppression capabilities when the systems were properly maintained, but unfortunately keeping the systems functional has proven to be both time consuming and expensive due to the propensity for damage to the in-rack system components.

To fully understand the optimum fire protection requirements for unique facilities such as high bay cold storage facilities, it is important to first understand the basis from which current prescriptive requirements were derived.

COMMODITY CLASSIFICATION

One of the key criteria for determining appropriate storage protection is the proper commodity classification of stored material. Stored commodity can generally be categorized into one of the following groups listed in order of potential fire severity:

Class 1 – Non-combustible product that is:

- Placed directly on wooden pallets OR
- Placed in single layer corrugated cartons with or without pallets OR
- Shrink or paper wrapped as a unit with or without pallets

Class 2 – Non-combustible product that is

- In slatted wooden crates or solid wood boxes OR
- In multiple layered corrugated cartons OR
- Equivalent combustible packaging material

Class 3 – A combustible product fashioned from

- Wood, paper or natural fibers
- Group C Plastics (charring plastics such as PVC)
- No more than 5% by weight or volume Group A or B plastics

Class 4 – a combustible product constructed totally of Group B plastics (i.e. Nylon)

- Contained within itself or its packaging by 5% to 15% by weight or 5% to 25% by volume of Group A plastics
- Group A Plastics (i.e. unexpanded polystyrene)
- Exposed, Expanded Plastics (i.e.

expanded polystyrene otherwise not contained)

To enable repeatable full scale fire testing and allow comparison of results between tests, specifically defined laboratory commodity has been developed to represent each of these commodity classes.

BASIS OF NFPA 13 STORAGE REQUIREMENTS

The modern storage fire protection requirements were developed by conducting a series of full scale fire tests in the late 1960's and early 1970's to develop standard water density base storage curves for 20 ft of storage under a 30 ft ceiling. The majority of these tests were performed for Class II commodity, with other commodities assumed to have curves parallel to the class II curve. Figure 1 demonstrates the base storage curves overlaid with the test points used to generate those curves.

One representative test used to develop the base curve was a wet system test of 20 ft of commodity under a 30 ft ceiling with ceiling only protection at a design density of 0.3 gpm/ft^2 resulted in a sprinkler operating area of 4500 to 4700 ft^2, complete consumption of about 22% of the storage commodity, and isle jump to both the north and south target array. Figure 2 demonstrates the approximate damage limits for one of the tests conducted. These base curves still exist in NFPA 13 today, noting that no safety factor was applied in the translation of the full scale fire test results to the area-density curves found in the standard.

This initial test series was extended to develop installation criteria for in-rack sprinklers. A total of 18 tests were conducted to evaluate in-rack sprinklers to protect Class II commodity. Of these 18 tests, 15 evaluated the use of in-rack sprinklers for storage heights less than 30 ft. 3 of the tests evaluated storage heights of 30 ft. All three tests included a ceiling density of 0.3 gpm/ft^2, in rack spacing between 8 and 12 ft, and between 2 and 5 lev-

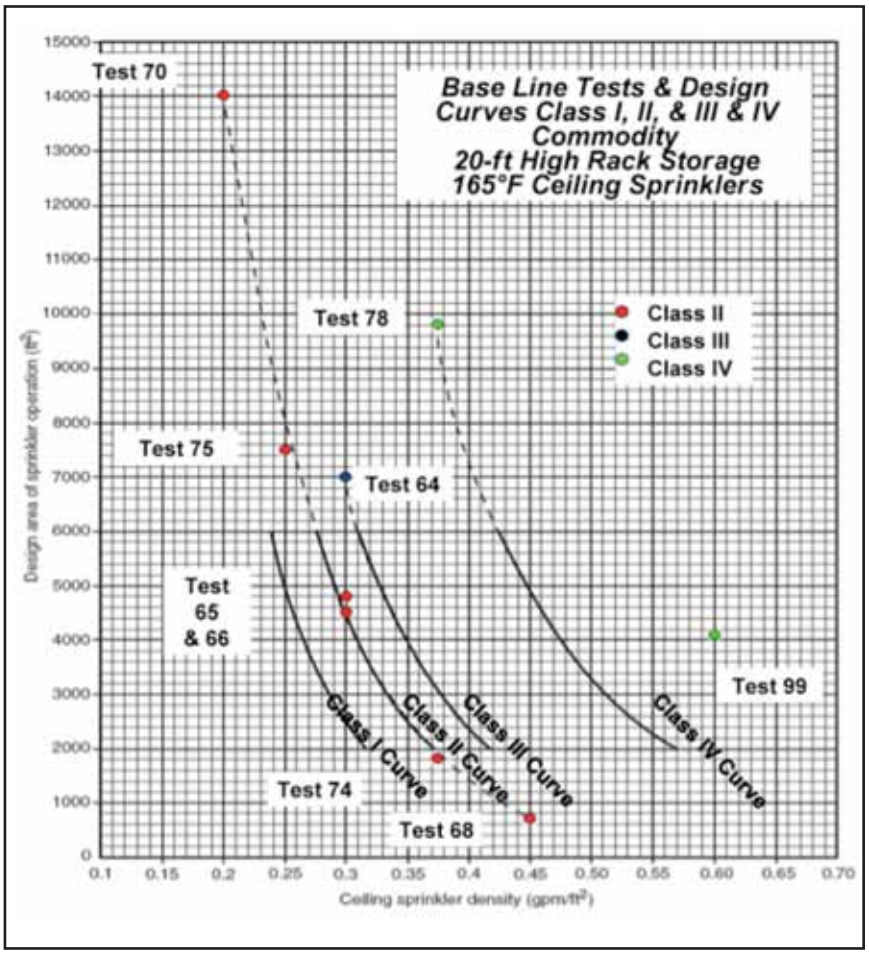

Figure 1: Base Storage Curves and Supporting Tests

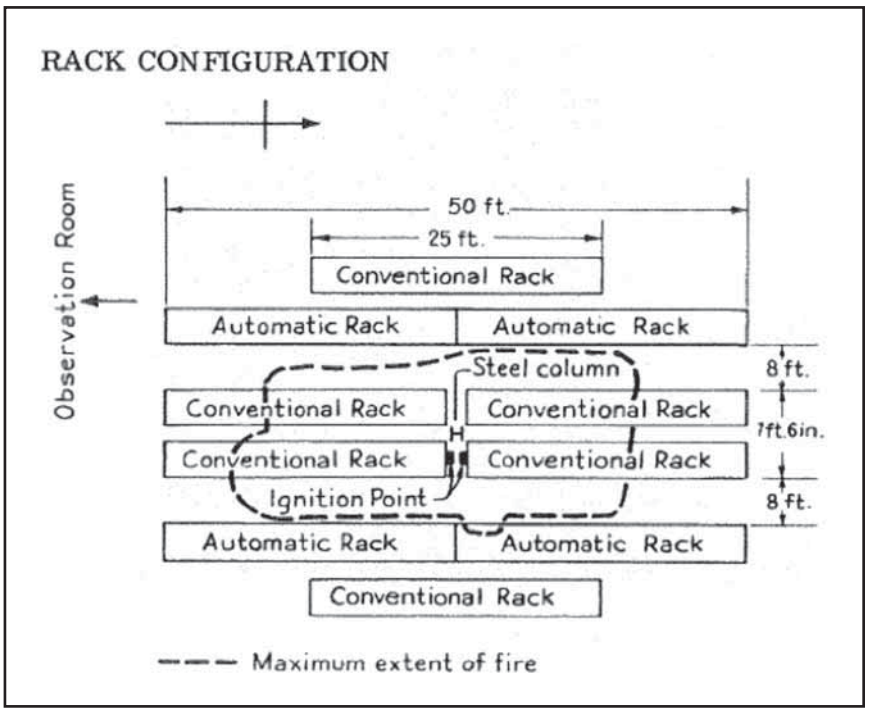

Figure 2: Fire Damage Estimate for Test 65

els of in-rack sprinkler. The total number of sprinklers operated in these tests ranged from a minimum of 26 to a maximum of 44, with the total number of in-rack sprinklers operated ranging from a minimum of 9 to a maximum of 14. The impact of water delivery delay due to the use of dry systems was not evaluated as part of this program.

Figure 3 demonstrates the in-rack sprinkler layout, and the typical damage extents for the series of 30 ft class II fire tests.

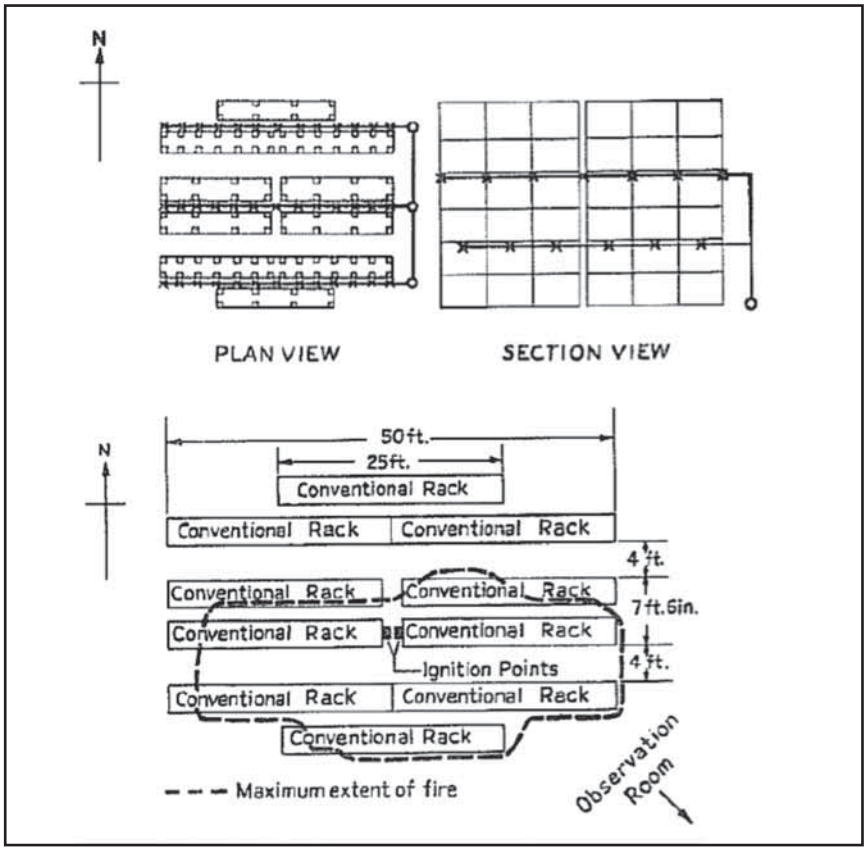

Figure 3: In Rack Sprinkler Arrangement and Fire Test Damage – Wet System Test

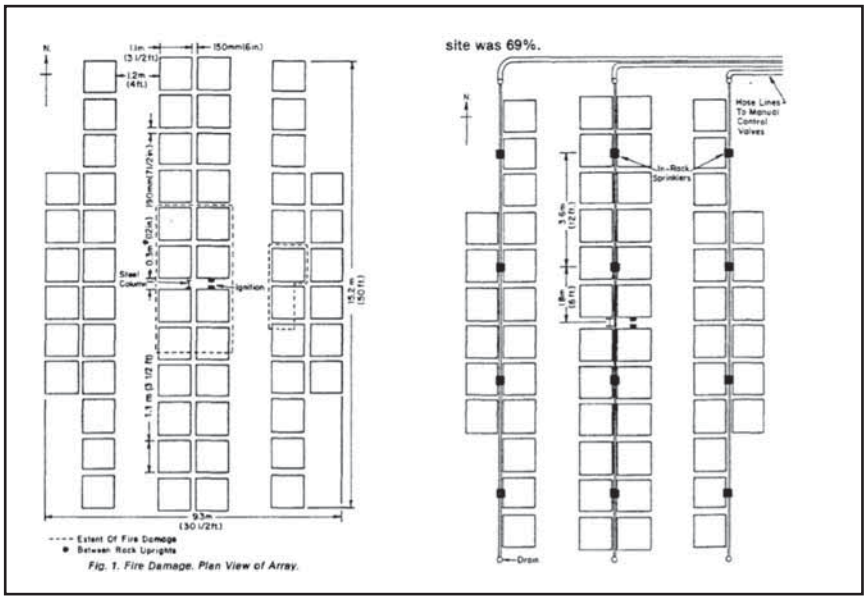

Figure 4: 1981 FM Dry System Test - Fire Damage and In-Rack Sprinkler Layout

The majority of rack storage testing of in-rack sprinklers is limited to the evaluation of wet pipe sprinkler systems. Available test records indicate that only one test has been conducted which attempts to evaluate the use of dry systems in combination with in-rack sprinklers. The test was conducted at Factory Mutual on May 11, 1981 under the following parameters:

- 20 ft of Class II Commodity under a 30 ft ceiling
- 160 F, 5.6K Ceiling Sprinklers installed on 10 ft x 10 ft spacing
- Ceiling sprinkler discharge density of 0.3 gpm/ft^2
- 5.6K 165F in rack sprinklers installed in the longitudinal flue above the second tier of storage on 12 ft centers
- In-rack discharge density of 22 gpm
- Water delivery delay of 59 seconds

This test resulted in the operation of 2 in-rack and 92 ceiling sprinklers and a total measured water flow of 2850 gpm. Figure 4 demonstrates the in-rack sprinkler layout and the extent of damage.

Figure 4: 1981 FM Dry System Test - Fire Damage and In-Rack Sprinkler Layout

The 1999 edition of NFPA 13 would permit a 60 second water delivery delay to operated sprinklers. During testing of 40 ft of Class III storage under a 45 ft ceiling at Underwriters Laboratories, a 60-second water delivery delay resulted in the operation of all 100 standard response, high temperature, sprinklers installed in the large scale test ceiling.

Under ideal circumstances, test data designed to specifically evaluate the protection of 40 ft of Class II commodity, protected in accordance with the 1999 edition of NFPA 13 using a 0.3 gpm/ft^2 ceiling density and two levels of in-rack sprinklers and employing a 60

seconds water delivery delay would be available. As this testing has not been conducted, estimates of performance can only be based upon the data presented above, which demonstrates that the likelihood of such a system to provide adequate protection is low.

NFPA standards are intended to provide the minimum level of acceptable performance; however in many cases it is appropriate to exceed these minimum requirements to achieve specific property loss, business interruption, or life safety objectives.

DEVELOPMENT OF SYSTEMS SPECIFICALLY FOR COLD STORAGE OCCUPANCIES

The limited testing data available brings into question the effectiveness of in-rack sprinklers in large, dry pipe systems such as those historically found in high bay cold storage facilities. Further, while the trouble associated with damage to in-rack sprinklers in all storage environments is commonly understood, this problem is greatly magnified in the cold storage environment. A tumbling carton or careless pallet retrieval can result in near simultaneous damage to both an in-rack sprinkler and nearby LHD wire, resulting in a flooded (and rapidly freezing) cold storage area. As it is usually impossible to "thaw out" such a large facility, remediation of a flooded sprinkler system requires complete disassembly of all piping, removal to a heated area for thawing, and then reassembly. Adding to the expense of this process is the need for all work to be conducted in a fully refrigerated and operating cold storage warehouse.

Believing that a better solution was possible, Manufacturers undertook an extensive review of cold storage fire suppression requirements including fire performance, cost and dependability. As part of this program, Tyco Fire Protection Products initiated a series of experiments and analysis to determine how to best provide ceiling only fire protection using dry systems for these types of facilities. The end result of this program is better technology specifically tailored to meet the unique needs of the cold storage industry.

BASIS OF CONTEMPORARY COLD STORAGE FIRE PROTECTION SYSTEMS

Modern cold storage fire protection systems designed and installed in accordance manufacturer's guidance provide a level of performance significantly exceeding the minimum performance required by NFPA 13 compliant systems. Unlike traditional sprinkler technology, these systems have been designed and tested specifically as a dry system. As a result, more stringent criteria, such as a maximum water delivery delay of 25 seconds and water volume requirements nearly 3 times greater than code compliant systems have been imposed specifically to address the challenges of double interlock Preaction (dry pipe) protection of rack storage. Additionally, high quality devices have been integrated into the system component package to ensure that the performance of the system does not degrade as systems age. For example, all components required for the implementation of a Tyco Quell™ system have been evaluated and tested by Tyco engineers to eliminate potential pitfalls and performance variations resulting from contractor selection and integration of devices which have not been evaluated for compatibility.

To ensure maximum flexibility, full scale fire testing used to develop cold storage criteria is generally performed using either Class III or Group A plastic test commodity. Figure 5 demonstrates the standard class III commodity configuration. Standard class III commodity is characterized by a very high ratio of surface area to density, which promotes extremely fast flame spread. The paper cups in individual compartments are ideal for promoting fire spread into the core of the commodity consistent with a cartooned combustible commodity.

To compare to previous test results, in one representative test first water arrived at the sprinklers 26 seconds after the first sprinkler operation, 20 psi was reached 35 seconds after first operation, and full pressure was achieved 57 seconds after first sprinkler operation. A total of 28 sprinklers operated during the test.

Figure 5: Standard Class III Commodity typically

In a second test, water arrived at the open sprinklers 11 seconds after first sprinkler operation, and the full design pressure of 30 psi was achieved 15 seconds after first sprinkler operation. A total of 25 sprinklers operated during the test.

In both tests, fire damage was limited to the center two bays of the main array and the north target array. Peak temperatures of steel angle attached to the ceiling directly over the ignition location was

426 °F and 311 °F for the first and second tests, respectively.

Based on full scale fire testing such as these, modern protection for cold storage occupancies generally are comparable to the following two examples:

40 ft. of Class II Commodity under a 48 ft. Ceiling

- 25 second maximum water delivery time to the pneumatically most remote area
- 8 second minimum water delivery time to the pneumatically least remote area
- 25 head hydraulic design calculated as 5 heads on 5 branch lines
- design discharge density of 0.92 gpm/ft^2

40 ft. of Class III Commodity under a 48 ft. Ceiling

- 25 second maximum water delivery time to the pneumatically most remote area
- 8 second minimum water delivery time to the pneumatically least remote area
- 30 head hydraulic design calculated as 5 heads on 6 branch lines
- design discharge density of 0.92 gpm/ft^2

These criteria provide a system with greater performance than a system complying with the 1999 requirements of NFPA 13 employing in-rack sprinklers as substantiated by the underlying test data.

Several alternative protection technologies have been attempted in an effort to further simplify these systems, mostly relying upon antifreeze agents in conjunction with ESFR sprinklers. The success of this approach has been limited due a variety of issues including difficulty in making leak tight joints, corrosion problems, cost of antifreeze solution, and the potential for increased fire growth during the antifreeze discharge period when propylene glycol based agents are employed. These alternative approaches have ultimately proven to be only a slight improvement over the in-rack problem they were designed to solve.

Modern cold storage fire protection methods and technologies have significantly improved the performance and dependability of these systems, while also addressing the challenges associated with historical techniques. However, with cold storage facilities getting taller, larger, and employing automated storage and retrieval systems resulting in greater storage densities, there will continue to be a need for further innovation to ensure that buildings meet life safety, property protection and business interruption objectives without negatively impacting facility operations. ■

Analyzing Overpressure Scenarios

from the technical **DEPARTMENT**

TONY LUNDELL, IIAR ASSISTANT TECHNICAL DIRECTOR, CIRO, PMP

When isolating equipment that contains liquid anhydrous ammonia, the potential exists for it to become over pressurized due to thermal expansion effects. The overpressure from liquid expansion could then result in the rupture and loss of ammonia from the equipment. And that rupture and loss, if large enough, could potentially have a serious or catastrophic consequence.

Liquid and vapor anhydrous ammonia expand and contract with changes in pressure and temperature. For example, if 0°F liquid anhydrous ammonia is in a partially filled, closed container and it absorbs enough heat to increase to 68°F, the volume of the liquid will increase by about 10 percent. If the same container is 90 percent full at 0°F, it will become 99 percent full when it reaches 68°F. At the same time, the pressure in the container will increase from 16 pounds per square inch gauge (psig) to 110 psig.

Thermal expansion results in the physical change of size of the ammonia molecules due to higher thermal energy of the object. Heat (thermal energy) when absorbed into the ammonia causes increased atomic motion. This change in the kinetic energy of the atoms and molecules causes it to increase in volume. It is a physical characteristic of matter as opposed to a chemical characteristic. The mass of the ammonia remains the same, while its volume increases and its density decreases.

Equipment and piping sub-sections that can be isolated and can trap liquid ammonia should be protected against overpressure due to thermal expansion:

a. automatically during normal operation;

b. automatically during shutdown by any means, including an alarm or a power failure;

c. during planned standby or seasonal conditions (e.g. situations when the valves in the ammonia lines to/from evaporative condensers are closed during cold weather conditions);

d. and, in situations with an equipment or component fault.

Protection can be accomplished in these situations by either installing a hydrostatic relief device or check valve that relieves to another part of the closed-circuit system or an expansion compensation device.

The manual isolation of equipment and piping sub-sections, for any purpose, should be undertaken by trained technician(s) taking all necessary precautions to protect against overpressure due to thermal expansion of trapped liquid ammonia.

If trapping of liquid with subsequent thermal expansion can occur only during maintenance – i.e. when trained technician(s) are performing maintenance tasks, either engineering controls or administrative controls should be used to relieve or prevent the overpressure.

Where Lockout/Tagout is required for the energy control, the procedure and training should be in compliance with OSHA 29 CFR 1910.147, Control of Hazardous Energy.

Refer to Standard ANSI/IIAR 2-2008 (With Addendum B), Section 11.4, Equipment and Piping Hydrostatic Overpressure Protection for control requirements to protect against overpressure due to thermal expansion.

The refrigeration management plan of the ammonia system, which is subject to OSHA's Process Safety Management (PSM) and the EPA's Risk Management Plan (RMP) if it contains at or over the threshold quantity of 10,000 lbs., or at a minimum, the General Duty Clause, should include a process hazard analysis (PHA) that addresses the hazards of the process, which includes overpressure protection.

The analysis will include consequences of failures and human factors that must be addressed. Analyzing overpressure scenarios when isolating equipment or components to assure that methods for its prevention are implemented is crucial. It is critical that a current and accurate operating and maintenance procedure, on which the qualified operator(s) and technician(s) are trained, includes the appropriate steps to safely evacuate the liquid and isolate the equipment during maintenance to prevent overpressure.

An IIAR Member Alert was recently released to address this matter and it informed members that IIAR had received clarification from OSHA on an ongoing question surrounding OSHA's requirement for hydrostatic relief for various pieces of equipment, especially evaporative condensers. OSHA's position on the issue was originally that hydrostatic relief is required when equipment containing liquid can be isolated. That position was stated in an interpretation letter commonly known as "the Palmer letter." However, a few years ago, the agency unofficially noted that administrative controls, i.e. trained operators/technicians are acceptable when isolating equipment as outlined in Standard IIAR-2. Nevertheless, OSHA did not officially revise its position and the interpretation remained on the agency's website.

The inconsistency created confusion about OSHA's requirement. Therefore, IIAR pursued OSHA to encourage the agency to make an official decision on this issue. As a result, IIAR successfully convinced OSHA to remove its requirement for hydrostatic relief (e.g. during manual isolation for maintenance), provided administrative controls are used for the isolation, as outlined in Standard IIAR-2. ■

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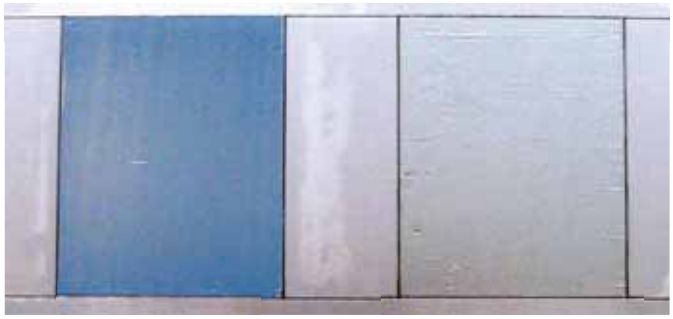

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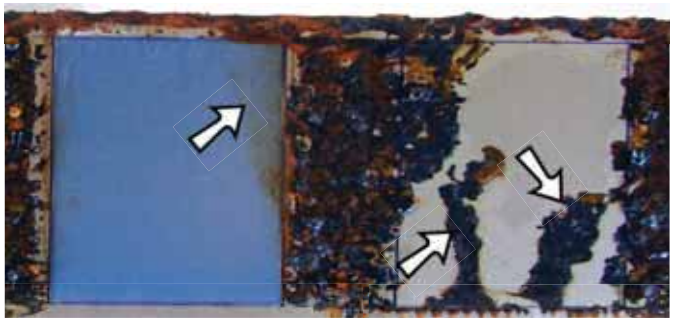

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